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U.S. EPA, Office of Environmental Cleanup
Region 10
Attn: Harbor Comments
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Re: Comments on Behalf of The Marine Group LLC and BAE Systems San Diego Ship Repair Inc. on the Proposed Plan for the Portland Harbor Superfund Site

Introduction

The Marine Group LLC (TMG) and BAE Systems San Diego Ship Repair Inc. (BAE Systems) submit the following comments to EPA's Proposed Plan (PP) for Portland Harbor Superfund Site[1] (Site). The U.S. Environmental Protection Agency, Region 10 (EPA) has identified both TMG and BAE Systems as potentially responsible parties (PRPs) at the Site in connection with the former operations of Northwest Marine Iron Works, Inc. (Northwest Marine).

Northwest Marine operated principally on Swan Island and within Swan Island Lagoon. EPA has designated this area from approximately River Miles 8.0 to 9.1 as a distinct sediment decision unit (the Swan Island Sediment Decision Unit, or SI SDU) in the PP and the underlying Feasibility Study (FS) for the Site.

TMG and BAE Systems have identified fundamental flaws with EPA's remedy selection in the PP and the FS, particularly as it would be implemented in the SI SDU. EPA must correct these flaws prior to issuance of the Record of Decision (ROD). In the PP, EPA has selected a preferred remedy that is inconsistent with the letter and intent of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the National Contingency Plan (NCP). EPA has neglected, dismissed, or incorrectly evaluated a number of important considerations – such as the potential for post-remedy sediment recontamination, the navigational depth requirements within the SI SDU, and the cost and duration of remedy implementation – resulting in an arbitrary and capricious remedy selection process.

The approach outlined in the PP, if finalized in a ROD, will result in a needlessly burdensome, lengthy, and expensive remedy attempt that will fail to meet EPA's long-term remedial goals. The issues outlined in these comments must be addressed now, prior to finalization of the remedy in

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[1] EPA, 2016. Superfund Proposed Plan for the Portland Harbor Superfund Site, Multnomah County, Oregon, Superfund ID # ORSFN1002155, June 2016.

the ROD, because they go beyond what can be properly addressed through Explanations of Significant Difference or ROD Amendments after remedy selection. TMG and BAE Systems make the following specific requests:

- EPA should consider existing new sediment and fish tissue data that strongly supports the application of monitored natural recovery (MNR) within the SI SDU into its remedy evaluation and selection process;

- EPA should acknowledge that the stated long-term remedial goal for polychlorinated biphenyls (PCBs), one of the principal chemicals of concern (COCs) at the Site, of nine micrograms per kilogram (μg/kg) or lower is not achievable and should revise the remedial goal to account for the limitations of source control efforts in a working industrial harbor as well as background concentrations that exceed EPA's remedial targets;

- EPA should correct the flawed assumptions regarding future maintenance dredging requirements and propeller wash (propwash) disturbance depths in the SI SDU, and should reevaluate potential remedial technologies within the SI SDU based on these corrected assumptions;

- EPA should reevaluate its definition and designation of "highly toxic" principal threat waste (PTW) within the SI SDU as the definition currently used by EPA results in clearly excessive volumes of sediment being characterized as PTW; and

- EPA should correct its flawed estimates of construction duration and cost for the considered remedies in order to ensure an accurate remedy comparison and selection process.

The following comments address these key issues to assist EPA in correcting the PP and underlying FS to ensure that the remedy ultimately selected in the ROD is supported by defensible, science-based assessments of sediment remediation, proper assumptions and the facts of this Site. These comments also outline a conceptual alternative remedy for the SI SDU (developed by a group of stakeholders called the Swan Island Group) that provides the same level of protectiveness as EPA's preferred remedy but in a substantially more cost-effective, sustainable, and less disruptive manner.

Key Concerns with EPA's Proposed Plan

1. EPA Failed to Consider Current Site Data that Establishes the Effectiveness of Natural Recovery Processes in the SI SDU

TMG and BAE Systems are concerned that EPA's analysis in the PP and the underlying FS is based upon site-wide sediment data collected before 2008[2] and fish tissue data collected before 2008,[3] leading to the erroneous conclusion that *"MNR is not occurring in Swan Island Lagoon at a rate sufficient to reduce risks within an acceptable time frame."*[4] EPA ignored sediment data collected in 2014 that shows significant decreases in contaminant concentrations within the SI SDU. These data were submitted to EPA on August 7, 2015, well before issuance of the PP in June 2016.[5] The 2014 data provides strong support for the applicability and efficacy of natural recovery within the SI SDU, and it should have been considered.

In March 2016, twenty additional surface sediment samples were collected within the SI SDU to assess whether surface sediment concentrations of PCBs had decreased through the natural recovery process. On August 16, 2016, these additional data were provided to EPA as part of an update to TMG's and BAE Systems' 104(e) information request responses.[6] A report summarizing the sampling results is attached to these comments as Exhibit 1 and is also depicted visually on Figure 1 of these comments. The recent data provide even more evidence that natural recovery is occurring within the SI SDU at rates much higher than recognized by EPA. Seventy-five percent of these samples show reduced PCB concentrations relative to previously reported data, with an average of 61% reduction, when compared with samples collected over a decade earlier by the Lower Willamette Group (LWG). These results confirm the trends seen with sediment PCB concentrations in the 2014 data. Because this recent data has not been considered or incorporated in EPA's Final Remedial Investigation (RI) (February 6, 2016), the FS, or the PP, the characterization of Swan Island Lagoon by the EPA as an area where natural recovery is

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[2] EPA, 2016. Superfund Proposed Plan for the Portland Harbor Superfund Site, Multnomah County, Oregon, Superfund ID # ORSFN1002155, June 2016, p. 7 and associated references in EPA, 2016. Portland Harbor RI/FS, Remedial Investigation Report, Final, February 8, 2016, e.g. Appendix A, Data Sources and Site Characterization/Risk Assessment Database, Final.
[3] EPA, 2016. Portland Harbor RI/FS, Remedial Investigation Report, Final, February 8, Appendix F, Baseline Human Health Risk Assessment, Final, March 28, 2013, Table 2-7.
[4] EPA, 2016. Superfund Proposed Plan for the Portland Harbor Superfund Site, Multnomah County, Oregon, Superfund ID # ORSFN1002155, June 2016, p. 32.
[5] Schnitzer Steel Industries, Inc. et al., 2015. Natural Recovery of Sediments Affected by PCBs in Portland Harbor, letter to Jim Woolford and Cami Grandinetti, EPA, August 7, 2015 including the following report as an attachment: Kleinfelder, 2015. Sediment Sampling Data Report. Portland Harbor, Portland, Oregon. Prepared by Kleinfelder, Inc., Redmond, Washington. Prepared for de maximis, Inc., The Woodlands, Texas. Kleinfelder Document Number 20153027.001A/SEA15R15419. June 1, 2015.
[6] TMG, 2016. Portland Harbor Superfund Site Information Request Supplemental Responses from The Marine Group LLC for Ship Repair Operations, submitted to EPA, August 16, 2016 and BAE Systems, 2016. Portland Harbor Superfund Site Information Request Supplemental Responses from BAE Systems San Diego Ship Repair Inc. for Ship Repair Operations, submitted to EPA, August 16, 2016.

prohibitively slow-acting is not correct. These recent data show that the viability of MNR within Swan Island Lagoon needs to be reassessed prior to the issuance of the ROD and that MNR should be included as an applicable remedial technology within the SI SDU.

A comparison of pre-2014 and post-2014 surface sediment surface-weighted average concentrations (SWACs) of total PCBs within the SI SDU further shows that natural attenuation of surface sediments is occurring. For this analysis, SWACs were estimated using the Thiessen polygon method, as described in Appendix I of the FS.[7] In brief, each surface sediment sample is assigned a unique polygon, and the SWAC is then calculated from this formula:

$$SWAC = \frac{\sum C_p * A_p}{A_{SDU}}$$

Where:

- C_p is total PCB concentration based on the sample within a given polygon;
- A_p is the area of each polygon; and
- A_{SDU} is the total area of the SI SDU.

Figure 2 presents the resulting polygons using pre-2014 sediment data from the LWG RI/FS database, and Figure 3 presents the polygons using post-2014 sampling from the two sediment investigations performed in 2014 and 2016 to update collocated sediment samples from the RI/FS database.[8] The pre-2014 SWAC calculated for the SI SDU is 469.8 μg/kg, whereas the post-2014 SWAC is 166.8 μg/kg. This is a 64.5% reduction.

Additionally, fish tissue data collected from the Site in 2011 and 2012 demonstrate that fish consumption risks reported in the FS are overestimated using the earlier 2002 and 2007 data from the RI. For smallmouth bass collected from the Site in 2011 and 2012, whole body PCB fish tissue concentrations ranged from 92.3 to 6,465 μg/kg (LSS, 2015).[9] Within the SI SDU, which was identified in the RI as having some of the highest PCB-related risks, PCB fish tissue concentrations collected in 2012 ranged from 172 to 1,060 μg/kg.[10] Using an upper-bound estimate of the mean,

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[7] EPA, 2016. Superfund Proposed Plan for the Portland Harbor Superfund Site, Multnomah County, Oregon, Superfund ID # ORSFN1002155, June 2016, Appendix I, Surface Weighted Average Concentration Uncertainty Analysis (PCBs, Total PAHs, DDx).

[8] Note, this analysis assumes a U=0 treatment of non-detect PCB congener/Aroclor data, while EPA's RI/FS database assumes a U=1/2 treatment of non-detect PCB congener/Aroclor data. While neither method is consistent with EPA guidance (e.g., EPA, 2013. ProUCL Version 5.0.00 User Guide, Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations, September, pp. 27-28), the treatment of non-detect using a U=0 approach allows for the comparison of SWAC values without the convolution of changes in detection limits between sampling events.

[9] Legacy Site Services LLC, 2015. An Assessment of the Coupled Sediment Recovery and Dynamic Food Web Model: Predicting the Concentrations of Total PCBs in Lower Willamette Fish Tissue Based on 2002 to 2012 Sampling Data, July 15, 2015, pp. 34-35.

[10] Kennedy/Jenks, 2013. Memorandum to the Lower Willamette Group: Statistical Comparison of Historical and 2012 Smallmouth Bass Data, March 6, 2013.

the 95% upper confidence limit (95% UCL) of Site-wide PCB concentrations is 1,104 μg/kg and the SI SDU-specific 95% UCL is 644 μg/kg. Using the FS ratio for whole body to fillet concentrations of 8.02 for PCBs,[11] these correspond to PCB concentrations of 138 and 80 μg/kg in fish fillet Site-wide and in the SI SDU, respectively. For subsistence fishers, 138 and 80 μg/kg correspond to cancer risks of 3E-04 and 2E-04, respectively. In the case of recreational fishers, these concentrations correspond to a Site-wide and SI SDU risks of 9E-05 and 5E-05, respectively, which are within the EPA's acceptable risk range.[12]

In contrast to these specific data, the PP provides only qualitative evaluation of natural recovery.[13] EPA's analysis is based on an over-simplified assessment of natural recovery using an arbitrary subset of criteria provided in EPA's sediment remediation guidance.[14] The National Remedy Review Board expressed concern with EPA Region 10's assessment of natural recovery at this Site, stating that *"the Region provided relatively limited, qualitative evidence for natural recovery. Furthermore, the modeling information was incomplete*."[15] EPA Region 10's generalized response that the Region *"used several other* [than modeling] *lines of evidence that indicate natural recovery is occurring at different rates within the study area"*[16] conflicts with its determination that the SI SDU is the only portion of the Site where natural recovery is not occurring at a rate sufficient to qualify as a viable remedial option for this sediment decision unit.

The additional Site investigations performed in 2014 and 2016 provide a robust dataset for EPA to correct this deficiency by quantitatively evaluating natural recovery using Site-specific data rather than a set of arbitrary criteria. The fact that natural recovery has been occurring in the SI SDU, despite the source control issues discussed below in Section 2, further demonstrates the efficacy of natural recovery as a remedial option. An accurate estimate of natural recovery rates is critical for establishing an effective remedy. EPA's responsibility under the NCP when new information becomes available is clear:

> *After publication of the proposed plan and prior to adoption of the selected remedy in the record of decision, if new information is made available that significantly changes the basic feature of the remedy with respect to scope, performance, or cost, such that the remedy*

[11] EPA, 2016. Portland Harbor RI/FS, Feasibility Study, Final, prepared by EPA and CDM Smith, June 2016, Appendix B, Derivation of Risk-Based Preliminary Remediation Goals, Table B3-3.
[12] *Id.*, Appendix B, Derivation of Risk-Based Preliminary Remediation Goals, Table B3-5, which demonstrates that EPA evaluated an upper risk level of 1E-04 determination of human health preliminary remediation goals (PRGs).
[13] *Id.*, Appendix D, Supporting Information for Alternative Development, Section D8.
[14] EPA, Office of Solid Waste and Emergency Response, 2005. Contaminated Sediment Remediation Guidance for Hazardous Waste Sites, EPA-540-R-05-012, December 2005, Section 4.4, pp. 4-9 – 4-10.
[15] EPA, Office of Solid Waste and Emergency Response, 2015. National Remedy Review Board and Contaminated Sediment Technical Advisory Group Recommendations for the Portland Harbor Superfunds Site, Memorandum, December 31, 2015, p. 9.
[16] EPA, Region 10, 2016. Region 10 Responses to National Remedy Review Board and Contaminated Sediments Technical Advisory Group Recommendations for the Portland Harbor Superfund Site, Memorandum, January 21, 2016, p. 15.

significantly differs from the original proposal in the proposed plan and the supporting analysis and information, the lead agency shall:

(A) Include a discussion in the record of decision of the significant changes and reasons for such changes, if the lead agency determines such changes could be reasonably anticipated by the public based on the alternative and other information available in the proposed plan or the supporting analysis and information in the administrative record; or

(B) Seek additional public comment on a revised proposed plan, when the lead agency determines the change could not have been reasonably anticipated by the public based on the information available in the proposed plan or the supporting analysis and information in the administrative record. The lead agency shall, prior to adoption of the selected remedy in the ROD, issue a revised proposed plan, which shall include a discussion of the significant changes and the reasons for such change, in accordance with the public participation requirements described in paragraph (f)(3)(i) of this section.[17]

TMG and BAE Systems expect that EPA will follow these requirements of the NCP and properly consider and document consideration of the new, relevant data as part of the mandated remedy selection process.

2. EPA Set Unachievable Long-Term Remedial Goals due to Flawed Analysis of Source Control and Background Contaminant Concentrations

TMG and BAE Systems have significant concerns that the remedial alternatives, as outlined in the PP, will not achieve EPA's stated remedial goals due to the failure of the agency to fully consider ongoing sources of stormwater contamination and upriver sources combined with a statistically flawed approach to calculating background concentrations, particularly for PCBs. The PP assumes that *"[a]ll alternatives equally rely on the adequacy of DEQ's source control to achieve PRGs and RAOs and to prevent recontamination of the Site."*[18] However, the PP needs to recognize that source controls reduce (but not eliminate) contaminant inputs from stormwater discharges to the Site. In addition, EPA presents preliminary remediation goals (PRGs) for PCBs based on a statistical calculation of background concentrations that eliminates elevated sample results by inaccurately identifying them as outliers.[19] Prior to issuance of a ROD, a re-evaluation of both

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[17] C.F.R. Title 40, Part 300, Subpart E, §300.430(f)(3)(ii).

[18] EPA, 2016. Superfund Proposed Plan for the Portland Harbor Superfund Site, Multnomah County, Oregon, Superfund ID # ORSFN1002155, June 2016, p. 58.

[19] LWG, 2014. Reply in Support of Request for Dispute Resolution of EPA's Notice of Decisions on Background Regarding Section 7 of the Remedial Investigation (Lower[sic] Willamette River, Portland Harbor Superfund Site, EPA Docket No: CERCLA-10-2001-0240, Email to Richard Albright, EPA, October 14, 2014.

background and long-term stormwater discharge concentrations, particularly for PCBs, should be performed in order to select an achievable remedy.

The successful implementation of remedial actions at contaminated sediment sites is contingent upon selecting cleanup levels – including remedial action objectives (RAOs) based on appropriate or refined PRGs – that are attainable and sustainable. As stated in EPA's Contaminated Sediment Remediation Guidance for Hazardous Waste Sites (Contaminated Sediment Guidance), when project managers are developing and selecting RAOs and associated cleanup levels, they *"should evaluate whether the RAO is achievable by remediation of the site or if it requires additional actions outside the control of the project manager."*[20] It is paramount that RAOs, and PRGs (that are the numeric expression of the RAOs) *"reflect objectives that are achievable from the site cleanup."*[21]

Portland Harbor (including upland and upstream areas) contains many commercial and industrial operations. In such settings, the Contaminated Sediment Guidance indicates that "*it is typically very important to include ongoing sources in the evaluation of what sediment actions may or may not be appropriate and what RAOs are achievable for the site.*"[22] The PP does not follow this directive and fails to provide sufficient detail to ensure that known contaminants from stormwater discharge and upstream sources are controlled prior to remedy implementation, and that the PRGs selected for the Site are achievable given the commercial and industrial activity within and upriver of the Site.

Both public and private stormwater outfalls discharge into the Site including into the SI SDU.[23] Many upland stormwater basins discharging to the Site have been deemed by the City of Portland, and certified by the State of Oregon, Department of Environmental Quality (DEQ), as having completed "source control evaluations," but source control does not equate to contaminant elimination.[24] The upstream sediment and stormwater drainage basins continue to discharge COCs into the Site at levels above EPA-designated sediment background values and PRGs, particularly for PCBs.

Additionally, recent City of Portland stormwater outfall data indicate that contaminant levels in stormwater remain above, and in some outfall basins well above, joint source control strategy screening level values (JSCS SLVs) for these contaminants in the river (e.g., post-source-control-

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[20] EPA, Office of Solid Waste and Emergency Response, 2005. Contaminated Sediment Remediation Guidance for Hazardous Waste Sites, EPA-540-R-05-012, December 2005, p. 2-15.
[21] *Id.*, p. 2-15.
[22] *Id.*, p. 2-21.
[23] DEQ, 2014. Municipal Stormwater Source Control Report for Portland Harbor, City of Portland Outfalls Project, December 2013, amended February 2014, Figure 2-5.
[24] *Id.*, p. 6.

measure PCB concentrations in excess of 0.2 micrograms per liter (µg/L) from Outfall 22).[25] Specific to outfalls draining into the SI SDU, all of the sample-averaged PCB values for stormwater collected by the City of Portland exceeded the JSCS SLV for total PCBs.[26]

Because EPA has failed to recognize that DEQ's source control measures will not eliminate ongoing inputs from upland sources before remedy implementation, the preferred remedy is unlikely to succeed. A reevaluation of background values is required in order to establish scientifically defensible and technically achievable remedial goals for the Site. This reevaluation must account for the ongoing upland and upstream inputs of COCs to the Site. Furthermore, remediation and controls of upland sources under DEQ oversight will need to be completed before implementation of remedial action at the Site. Post-remedy monitoring data from point and non-point upland sources will need to be incorporated into the overall evaluation and identification of achievable long-term remedial goals for the SI SDU.

3. EPA's Duration and Cost Estimates are Flawed

TMG and BAE Systems are also concerned that EPA's construction duration and cost estimates for the remedial alternatives considered in the FS and PP are materially inaccurate due to arithmetic errors, invalid assumptions, and missing considerations. As a consequence, they do not provide reliable or accurate information for the purposes of screening or comparing the remedial alternatives. CERCLA requires EPA to evaluate the costs and cost-effectiveness of each considered remedy when selecting its preferred alternative. An accurate estimate of costs is an essential component of this evaluation. While EPA guidance recognizes that there will be some uncertainty about cost components at the alternatives analysis stage of the process,[27] this does not excuse the agency from preparing estimates that can be relied upon for decision making. The flaws discussed below have lead EPA to select a preferred alternative that is not the most cost-effective or appropriate for the Site as required by CERCLA.[28]

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[25] City of Portland, Bureau of Environmental Services, 2015. Source Control Measures Effectiveness Demonstration, City of Portland Outfalls Project, September 2015, Table A-2; Figure A-11.

[26] *Id.*, Table A-2; Figure A-11.

[27] USACE and EPA, 2000. A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, EPA 540-R-00-002, OSWER 9355.0-75, July 2000. Note that this guidance establishes that remedial costs during the remedy selection stage of the Superfund process are expected to be accurate within a range of -30% to +50%, *Id.*, p. 2-4.

[28] EPA states in the PP that "*[t]he specific information associated with SMA footprints, dredging depths, estimated volumes of dredged material and cap material, the thickness of caps and/or types of cap layers are assumptions for purposes of developing cost estimates for the remedial alternatives. These assumptions were developed based on the existing data and will be finalized during the remedial design, after design level data to refine baseline conditions are obtained.*" EPA, 2016. Superfund Proposed Plan for the Portland Harbor Superfund Site, Multnomah County, Oregon, Superfund ID # ORSFN1002155, June 2016, p. 37. The arguments in these comments regarding cost estimates address how the flaws in such estimates have created a preferred remedy selection process that violates the requirements of the NCP (40 C.F.R. 300.430(e)(9)(iii)). TMG and BAE Systems recognize that revised cost estimates will be prepared

3.1 EPA's Dredging Production and Duration Estimates are Flawed.

The dredging assumptions used in the PP approach are based on operating parameter assumptions that are not realistic or consistent with the United States Army Corps of Engineers' (USACE's) *Technical Guideline for Environmental Dredging of Contaminated Sediment* (USACE Dredging Guidance), which is an industry-standard resource used at environmental dredging projects throughout the United States.[29] See Table 1 for a comparison of some basic parameters between USACE Dredging Guidance and the EPA's assumptions in the PP.

Table 1 – USACE Dredging Guidance Operating Parameters vs EPA Proposed Plan Assumptions

Dredging Operating Parameter	USACE Dredging Guidance[30]	Portland Harbor PP and Underlying FS[31]
Bucket Size (cubic yards, CY)	3 to 10 CY	4 to 10 CY
Bucket Fill Factor (%)	50 to 65%	55 to 75%
Cycle Time (minutes)	2 to 8 minutes	0.84 to 2.45 minutes
Effective Working Time Efficiency (%)	55 to 70%	90%

EPA's application of operating parameters that are outside the boundaries of USACE's Dredging Guidance, particularly the cycle times and effective working time efficiency, results in a significant overestimation of the average daily dredging rates, as shown below in Table 2. Ultimately, the overestimation of dredge removal rates leads to significant underestimation of the overall duration and cost of the dredging portion of Alternative I, both Site-wide and specific to the SI SDU, thus skewing the EPA's cost-effectiveness evaluation of dredge-intensive remedial alternatives.

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once a remedy is formally selected in the ROD and reserve the right to make any and all arguments about the accuracy or reliability of those cost estimates at that time.

[29] USACE, 2008. Technical Guideline for Environmental Dredging of Contaminated Sediments, ERDC/EL TR-08-29, September 2008.

[30] *Id.*, pp. 68; 146; 142; 93-94.

[31] EPA, 2016. Portland Harbor RI/FS, Feasibility Study, Final, prepared by EPA and CDM Smith, June 2016, Appendix G, Cost Estimate Backup EPA-Derived MII Costs, pp. 10-12.

Table 2 – Comparison of Estimated Daily Dredge Removal Rates

Dredge Type	FS Estimate[32] (CY/day)	Revised Estimate[33] (CY/day)	EPA Overestimate Percentage
Confined Area (4 CY bucket)	1,190	680	75%
Open Water (10 CY bucket)[34]	4,760	3,360	42%

Additionally, the estimated dredge removal rates also do not take into account the significant challenges and constraints to realistic implementation of dredging and material transport within an operating marine facility such as the SI SDU. This failure results in dredge removal rates that are inconsistent with estimated rates using the USACE Dredging Guidance and previous project experience. The PP and the underlying FS also do not account for the time necessary to prepare dredging areas (e.g., installation and removal of sheet pile wall and the placement and removal of silt curtains), move operations from one dredge area to another, manage debris, implement construction-related best management practices, and place capping materials. In addition, the PP and the underlying FS incorrectly assume all debris removal, dredging, and capping activities will occur in sequence with no delay between each of these activities, an assumption which is not realistic. The duration estimates in the PP and the underlying FS also do not account for siting, and development of sediment and water staging, handling, treatment, and transloading facilities. Further, the PP and the underlying FS do not clearly address the potential effects of process bottlenecks at the transloading/water treatment facilities, delays due to roundtrip transport to the disposal facility, and lost time due to the requirement to move and reposition dredge vessels to avoid disrupting navigational (ship) traffic in the SI SDU. After estimating reasonable contingency time for the above considerations, the Site-wide remedy preferred by EPA is not implementable in the seven years estimated by EPA, and is more likely to take approximately upwards of eleven years to implement.

Based on dredge removal rates and volumes estimated in the FS, EPA estimates that Alternative I will take a total of seven years to construct.[35] Based on an estimate of dredge volume targeted in the SI SDU, the dredging of the SI SDU is estimated by the EPA to account for two years of this seven year period. However, when dredging duration calculations are run using parameters

[32] *Id.*, Appendix G, Cost Estimate Backup EPA-Derived MII Costs, pp. 10-17.

[33] This revised estimate assumes a 70% bucket fill factor, three-minute cycle time and 60% effective working time efficiency.

[34] The estimates for open water dredging assume that two dredges will be operating simultaneously, so this number is double the daily production rate for one open-water dredge.

[35] EPA, 2016. Superfund Proposed Plan for the Portland Harbor Superfund Site, Multnomah County, Oregon, Superfund ID # ORSFN1002155, June 2016, p. 62. This seven-year duration refers only to the in-river construction component of remedy implementation.

consistent with USACE's operational parameters described above and actual experience at other contaminated sediment sites, the estimated dredging duration for the SI SDU increases to approximately three years, or more than 50% greater than the duration presented in the PP.

3.2 EPA Has Ignored Geotechnical Issues Associated with Dredging

EPA has also failed to consider geotechnical issues related to dredging adjacent to improved shoreline areas in the PP. According to the PP, the areas in the SI SDU delineated by a blue line along the shoreline are designated as properties with known contaminated river banks, some fraction of which are designated to undergo remediation of the bank area.[36] The PP states *"[w]here SMAs are projected onto the river bank, removal followed by capping is the assigned remedial technology."*[37] However, EPA has failed to consider the technical and regulatory difficulties in dredging adjacent to river banks and associated over-water structures, or the increased costs that would be associated with implementing this river bank remedy as a portion of the overall Site remedy.

Due to the river-dependent uses of river frontage properties, banks are typically over steepened beyond the angle of repose associated with the native soils and sediments, and the angle is maintained by the presence of extensive arrays of piling, rip rap or bulkhead and overwater structures throughout the Site.[38] The FS shows that a large number of structures and pilings exist along the shoreline of the SI SDU.[39] Where such work is possible, it would be much more expensive and time-consuming than typical open-water dredging. EPA's assessment of riverbank excavation is overly general and is technically impractical given the highly developed nature of much of the Site riverbanks.

EPA has also failed to address the disruption and negative economic impact associated with a lengthy remedy. For example, EPA has not considered the logistical challenges associated with installation of sheet piling and other navigational obstructions[40] in the midst of active overwater industrial operations in the SI SDU. The PP states that *"site logistics of implementation also increase in difficulty as more construction acreage is added in each alternative"*[41] but fails to provide even a cursory discussion of how the remedy logistics will be coordinated. Additionally concerning is the fact that the PP's brief discussion of remedy effectiveness and implementability provides no substantive explanations for its comparison between remedial alternatives, instead

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[36] *Id.*, Figure 19e.

[37] *Id.*, p. 36.

[38] *Id.*, p. 11.

[39] EPA, 2016. Portland Harbor RI/FS, Feasibility Study, Final, prepared by EPA and CDM Smith, June 2016, Figure 3.4-23.

[40] *Id.*, p. 2-22.

[41] EPA, 2016. Superfund Proposed Plan for the Portland Harbor Superfund Site, Multnomah County, Oregon, Superfund ID # ORSFN1002155, June 2016, p. 57.

stating broadly that *"the potential for technical problems and schedule delays increases in direct proportion to the duration, amount of active remedy."*[42]

The PP does not go beyond generalities and does not actually assess the challenges of implementing a multiyear, dredge-focused remedy and entirely neglects a discussion of the negative impact on the livelihoods of the businesses and communities affected during the construction of the remedy. Take, for example, the number of barges and trucks estimated as required to transport dredged materials away from the Site. According to the PP and the underlying FS, EPA's preferred remedy Alternative I is estimated to require at least 1,160 barge loads of dredge material removal[43] over the seven year project over a four month work duration per year[44] for twenty-four hours a day, six days per week (122 days per year).[45] TMG and BAE Systems approximate that one-third of Site-wide dredge removal would occur within the SI SDU over a dredging period of approximately twelve months (i.e., three work years) of active sediment removal. Using the above estimate, EPA's preferred Alternative I would require the filling of at least one fully-loaded barge per day in the SI SDU during remedy construction to achieve an on-schedule remedy. The PP and underlying FS are silent on how this aggressive dredging schedule can be accomplished in a narrow lagoon used as part of an active industrial harbor. The PP and underlying FS are similarly silent on how the city of Portland can accommodate upwards of 200 truckloads of dredged and construction material being transported through the city on a daily basis during remedy construction.[46]

<u>3.3 EPA's Cost Estimates are Flawed and Unreliable for Use in EPA's Remedial Alternatives Comparison</u>

TMG and BAE Systems have identified several broad categories of problems with EPA's cost estimates for the remedial alternatives discussed in the PP and the underlying FS. Together, the breadth and magnitude of these problems demonstrate that the cost estimates provided in EPA's PP and underlying FS are inadequate for an accurate cost-effectiveness determination of the different remedial options presented in the PP.

Remedy duration costs. As described above, the remedy durations estimated by EPA are unrealistically short and result in inaccurate cost estimates for a number of remedial tasks including:

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[42] *Id.*, p. 57.
[43] EPA, 2016. Portland Harbor RI/FS, Feasibility Study, Final, prepared by EPA and CDM Smith, June 2016, Table 4.3-1, p. 10.
[44] *Id.*, Table 4.3-1, p. 7.
[45] *Id.*, p. 3-22.
[46] *Id.*, Table 4.3-1, p. 10. EPA estimates that either 163,028 (disposal material management scenario 1) or 190,750 (disposal material management scenario 2) truckloads of dredging and construction material. Assuming a seven-year duration, four-month work period and six-day work week (122 work days per year), this would result in either 192 or 224 truckloads of material transported into and out of the Site per day during active construction.

- Institutional Controls;
- Seasonal Mobilization/Demobilization;
- Material Processing (increased cost for land leasing and operations);
- Dredging;
- Capping; and
- Project Management/Construction Management.

Transloading facility costs. Although some costs related to the transloading facility are included in EPA's cost estimates, other key types of costs associated with constructing such a facility are omitted, unreliable, or contrary to EPA's own guidance:

- The costs for development of property into a transloading facility are originally derived as a lump-sum cost of $7,500,000[47] but are inconsistently applied in the remedial alternative-specific cost tables as a lump-sum cost of $4,508,000;[48]
- EPA is only assuming $45,080 for permitting the facility but total estimated construction costs for the transloading facility are $28.5 million. By using the general industry rule of thumb that permitting costs represent 0.5-2% of project construction costs, that leads to an estimate of approximately $356,000 in permitting costs;[49] and
- No costs are included for remediation of the transloading facility once it ceases to be used by the project.

Professional fees. The professional/technical services capital cost percentages used in EPA's cost estimates are contrary to the averages recommended even by EPA's own guidance documents for cost estimation.[50] The FS states *"[d]ue to the high overall costs for major work activities,"* EPA used lower percentages *"to better reflect realistic costs for professional/technical services."*[51] However, the EPA does not provide specific examples which would justify these reductions. Table 3 shows the difference between the percentages recommended by EPA in the EPA costing guidance and those in the FS for Portland Harbor.

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[47] *Id.*, Appendix G, Detailed Analysis Cost Estimates, Cost Estimate Backup - Previously Developed by Anchor QEA, Table 24.

[48] *Id.*, Appendix G, Detailed Analysis Cost Estimates, Table CW-I21.

[49] *Id.*, Appendix G, Detailed Analysis Cost Estimates, Cost Estimate Backup - Previously Developed by Anchor QEA, Table 24; RSMeans, 2015. Heavy Construction Cost Data, 29th Annual Edition, p. 13 (01 41 26.50 0010 – Permits).

[50] USACE and EPA, 2000. A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, EPA 540-R-00-002, OSWER 9355.0-75, July 2000.

[51] EPA, 2016. Portland Harbor RI/FS, Feasibility Study, Final, prepared by EPA and CDM Smith, June 2016, Appendix G, Detailed Analysis Cost Estimates, Attachment A, Methodology and Organization of Detailed Analysis of Cost Estimates, p. 9.

Table 3 – Capital Cost Element Percentages

Capital Cost Element	EPA FS Cost Estimate Guidance[52,53]	2016 Proposed Plan[54]
Project Management	5%	2%
Remedial Design	6%	2%
Construction Management	6%	3%
Contingency	20 to 45%[55]	20%

Cost Percentage Breakdown. The percentage breakdown of costs in the FS for Alternative I is inconsistent with actual cost breakdowns at other, similar contaminated sediment sites. Remediation at the Head of the Hylebos (conducted during 2004-2007) required two in-water working seasons to dredge 41.4 acres of sediment. Table 4 below shows a comparison of the actual cost breakdown at the Head of the Hylebos site and that reflected in EPA's cost estimates for Portland Harbor.

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[52] USACE and EPA, 2000. A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, EPA 540-R-00-002, OSWER 9355.0-75, July 2000, p. 5-13.

[53] Percentages to be applied to total of construction costs for project >$10M under EPA's cost estimation guidance. Such costs *"may be adjusted up for more complex projects or down for less complex projects." Id.*, pp. 5-12 – 5-13.

[54] EPA, 2016. Portland Harbor RI/FS, Feasibility Study, Final, prepared by EPA and CDM Smith, June 2016, Appendix G, Detailed Analysis Cost Estimates, Table CS-I.

[55] Range based on a scope contingency of 10 to 25% and a bid contingency of 10 to 20%.

Table 4 – Cost Breakdown Comparison

Remedial Tasks	Head of the Hylebos		Portland Harbor Estimates	
	Amount ($)	Percent of Total Capital Cost (%)	Amount ($)	Percent of Total Capital Cost (%)
Project Management, Monitoring, Fees	8,738,738	15%	48,487,238	7%
Mobilization & Demobilization	8,738,738	15%	10,854,000	1%
Debris Removal, Dredging, Excavation	9,903,903	17%	102,977,410	14%
Transloading Facility, Sediment Handling	6,990,990	12%	21,348,320	3%
Capping/Mitigation	n/a	n/a	134,922,628	18%
Transportation & Disposal/Water Management	21,555,554	37%	419,090,218	57%
Miscellaneous Other Costs	2,330,330	4%	3,482,238	0.5%
TOTALS	58,258,253	100%	741,162,051	100%

In addition to underestimating some categories of costs, EPA also entirely neglected to include numerous routine items in its cost estimate presented in its PP. TMG and BAE Systems have identified the following categories of costs that appear to be missing from the estimates prepared for Alternative I and the other considered remedies:

- Pre-design activities such as additional data collection and engineering investigations;[56]
- Federal and State agency oversight and participation costs;[57]
- Oregon Department of State Lands fees and costs;
- Permitting costs;[58]
- Easement costs;
- Contractor work plans and submittals;

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[56] LWG, 2016. Request for Dispute Resolution on EPA June 2016 Feasibility Study, Portland Harbor Feasibility Study, June 22, 2016, p. 17.

[57] *Id.*, p. 17.

[58] EPA, 2016. Portland Harbor RI/FS, Feasibility Study, Final, prepared by EPA and CDM Smith, June 2016, Appendix G, Table CW-I21. A general rule employed by remediation project planners for estimating permitting costs is to multiply the total project construction costs by between 0.5-2%. RS Means, 2015. Heavy Construction Cost Data, 29th Annual Edition, p. 13 (01 41 26.50 0010 – Permits). Doing so for this project would result in permitting costs magnitudes higher than what EPA has included in the FS cost back-up.

- Contractor payment and performance bonds;
- Environmental monitoring; and
- Critical structure/utility protection.

Given the scope of the remedy, these costs would likely be substantial.

The cost estimates supporting the 2016 FS and PP also differ materially from those put together by EPA itself in the draft FS issued in August 2015. This discrepancy seriously calls into question the reliability of EPA's cost estimates for purposes of comparing alternatives as required by the NCP. For example, the total estimated present value cost for Alternative E[59] in the draft FS was \$1,490,610,000[60] while the present value cost for Alternative E in the 2016 FS and PP was estimated at \$869,530,000.[61] This represents a \$621,080,000 (41%) reduction between the two estimates. While some portion of this cost differential appears to be due to a reduction in capping and dredging total areas, this alone would not account for such a large reduction in costs. EPA has failed to sufficiently explain the significant difference in its estimates, and no explanation arises from the underlying cost worksheets.

4. EPA Has Misstated Future Maintenance Depth Requirements and Propwash Disturbance is Flawed in the SI SDU

<u>4.1 EPA's Assumptions About Navigation Depths Needed for the SI SDU are Incorrect</u>

In the PP and the underlying FS, the majority of the SI SDU is arbitrarily designated as being an area of potential future maintenance dredging (FMD).[62] That is incorrect. Based on actual information provided by PRPs actively operating within the Swan Island Lagoon[63] very little maintenance dredging is or will be required or performed in the SI SDU. EPA failed to solicit or consider current site operational needs when designating the SI SDU as a primarily FMD area[64] stating only that additional information about future harbor operations would be evaluated in the remedial design process.[65]

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[59] Alternative I was not considered in the 2015 Draft FS. Alternative E is the closest alternative to preferred Alternative I.

[60] EPA, 2015. Portland Harbor RI/FS, Draft Final Feasibility Study Report, August 18, 2015, Appendix G, Detailed Analysis Cost Estimate, Table CS-ALT.

[61] EPA, 2016. Portland Harbor RI/FS, Feasibility Study, Final, prepared by EPA and CDM Smith, June 2016, Table 3.7-1.

[62] EPA, 2016. Portland Harbor RI/FS, Feasibility Study, Final, prepared by EPA and CDM Smith, June 2016, Figure 3.1-1.

[63] Swan Island Group, 2016. Portland Harbor Superfund Site, Swan Island SDU Optimized Remedial Alternative, submitted to EPA Region 10. September 6, 2016, Appendix A.

[64] EPA, 2016. Portland Harbor RI/FS, Feasibility Study, Final, prepared by EPA and CDM Smith, June 2016, Appendix C, Technology Assignment Supporting Documentation, p. C-2.

[65] *Id.*, p. 3-10; Appendix C, Technology Assignment Supporting Documentation, p. C-2.

The PRP-provided information about the current and future navigation depth requirements in the SI SDU reveals that very little ongoing navigation maintenance dredging is or will be required or performed in the SI SDU. The actual navigation uses and depth requirements (Figure 4)[66] differ substantially from the information used by EPA in the PP in terms of both the extent and depth requirements of future maintenance dredging. This updated information indicates that much of the SI SDU should be more accurately characterized as an intermediate zone under the PP's framework.[67]

TMG and BAE Systems are particularly concerned because EPA arbitrarily assumed that environmental dredging is the only viable remedial technique in FMD areas given the need to maintain navigation depths and the potential to disrupt in-place remedial technology such as caps:

> *SMAs within the federally authorized navigation channel or designated as FMD are assigned dredging as a technology due to minimum water depth requirements, the placement of thin sand layers, in-situ treatment amendments, and conventional or reactive caps because stand-alone technologies above the established navigation dredge depth are considered incompatible with current and future waterway uses.*[68]

However, as acknowledged by EPA, sediment deposition rates in the SI SDU are low.[69] Future maintenance dredging is not likely to be required within the SI SDU. In fact, the last time such dredging was performed in the central portion of the lagoon for the express purpose of maintaining the depth was in the 1950s.[70]

TMG and BAE Systems request that EPA incorporate the material new information provided by PRPs operating in the SI SDU regarding navigational dredge depth requirements and the potential for a combination of dredging and capping within FMD areas into its PP as mandated by the NCP.

<u>4.2 EPA's Assessment of Propwash is Overly Conservative and Contradictory</u>

Another major issue with EPA's PP for the SI SDU is that the agency's analysis of propwash contained in the underlying FS is overly conservative and is used to inappropriately restrict the assigned remedy to dredging.

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[66] Figure 4 of these comments is a copy of Figure 1 from Swan Island Group, 2016. Portland Harbor Superfund Site, Swan Island SDU Optimized Remedial Alternative, submitted to EPA Region 10. September 6, 2016.

[67] EPA, 2016. Portland Harbor RI/FS, Feasibility Study, Final, prepared by EPA and CDM Smith, June 2016, Figure 3.1-1.

[68] *Id.*, p. 3-10; see also EPA, 2016. Superfund Proposed Plan for the Portland Harbor Superfund Site, Multnomah County, Oregon, Superfund ID # ORSFN1002155, June 2016, p. 28.

[69] *Id.*, p. 32.

[70] Swan Island Group, 2016. Portland Harbor Superfund Site, Swan Island SDU Optimized Remedial Alternative, submitted to EPA Region 10. September 6, 2016, Appendix B.

EPA's analysis of propwash is largely based on propwash analysis conducted by the LWG.[71] However, despite using identical analyses, the EPA's conclusions are dramatically different from those reached by the LWG in terms of the impact of propwash and vessel scour at the Site. The LWG concludes that *"shallow propwash disturbance does not have a significant effect on the development of alternatives for the overall Site."*[72] In contrast, EPA concludes that *"[e]ngineered caps and armored caps were scored equally and were not considered appropriate in . . . propwash zones because of the likelihood of these environments to adversely impact the technology, thus, be less reliable and protective."*[73]

TMG and BAE Systems have two concerns over the EPA's characterization of propwash impacts on the viability of capping. First, EPA ignored the majority of its own propwash analysis and too conservatively focused on a minority of situations to restrict capping Site-wide, rather than appropriately considering that capping may have some isolated limitations given specific berthing and/or vessel conditions.[74] Additionally, EPA has not presented any Site-specific measurements of propeller-induced shear stress or sediment disturbance, instead relying on the presence of scour-pit at a few locations as evidence of substantial risk of propwash to capping.[75]

Second, EPA capriciously ignored the primary difference between armored and engineered caps by grouping the two together. This is particularly troubling because EPA expressly recognized that *"[a]rmored caps can generally be designed to prevent propwash-induced erosion."*[76] Further, EPA's multi-criteria decision matrix shows clearly that armored capping should be considered differently than engineered capping.[77]

EPA's analysis of these issues improperly screened out sediment capping (including armored capping) as a potential technology in areas which it has designated as being under the influence of propwash.

5. PTW can be Reliably Contained or Treated in the SI SDU

According to EPA's guidance document A Guide to Principal Threat and Low Level Threat Wastes (PTW Guidance):

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[71] EPA, 2016. Portland Harbor RI/FS, Feasibility Study, Final, prepared by EPA and CDM Smith, June 2016, Appendix C, Technology Assignment Supporting Documentation, Section C2.4.3, Propeller Wash Analysis; See also The Lower Willamette Group, 2012. Portland Harbor RI/FS, Draft Feasibility Study, prepared by Anchor QEA, LLC, Windward Environmental, LLC, Kennedy/Jenks Consultants, and Integral Consulting, Inc., March 30, 2012 Appendix FB, Evaluation of Propwash Disturbance Depths.
[72] *Id.*, p. 6.
[73] EPA, 2016. Portland Harbor RI/FS, Feasibility Study, Final, prepared by EPA and CDM Smith, June 2016, p. 3-13.
[74] *Id.*, Appendix C, Technology Assignment Supporting Documentation, Table C-20.
[75] *Id.*, Appendix C, Technology Assignment Supporting Documentation, p. C-19.
[76] *Id.*, p. 3-16.
[77] *Id.*, Figure 3.4-16.

> *Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur . . . No "threshold level" of toxicity/risk has been established to equate to "principal threat." However, where toxicity and mobility of source material combine to pose a potential human health risk of 10^{-3} or greater, generally treatment alternatives should be evaluated. . . . Determinations as to whether a source material is a principal or low level threat waste should be based on inherent toxicity as well as consideration of . . . the potential mobility of the wastes in the particular environmental setting . . . .* [78]

EPA's PTW Guidance also stresses that "*[t]he principal threat/low level threat waste concept and the NCP expectations were established to help streamline and focus the remedy selection process, not as a mandatory waste classification requirement.*"[79]

The PP includes three categories of PTW, which EPA describes as "highly toxic PTW," "PTW source material," and "PTW that cannot be reliably contained."[80] Per the PP, PTW within the SI SDU is neither "source material" nor "PTW that cannot be reliably contained."[81] However, EPA has arbitrarily categorized sediments within the SI SDU with PCB concentrations exceeding 200 μg/kg as "highly toxic PTW."[82]

EPA's PTW designation at this Site is inconsistent with its designation at other sites, described below, at which the designation and discussion of PTW focuses on the practicability of treatment of large volumes of both PTW and low level wastes. For example:

- Lower Duwamish Waterway Superfund Site: EPA Region 10 concluded that PTW for PCBs did not exist for the Lower Duwamish Waterway Superfund Site because PCBs in sediments were not highly toxic, despite maximum PCB concentrations in surface and subsurface sediments of 223,000 and 890,000 μg/kg, respectively[83]. These values are more than 1,000 and 4,000 times higher than the "highly toxic" concentration criterion that EPA

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[78] EPA, 2001. A Guide to Principal Threat and Low Level Threat Wastes, Superfund Publication 9380.03-06FS, November 2001, p. 2.
[79] *Id.*, p. 2.
[80] EPA, 2016. Superfund Proposed Plan for the Portland Harbor Superfund Site, Multnomah County, Oregon, Superfund ID # ORSFN1002155, June 2016, p. 14.
[81] *Id.*, p. 14; Figure 7; Table 7.
[82] *Id.*, Table 6.
[83] EPA, 2014. Record of Decision, Lower Duwamish Waterway Superfund Site, November 2014, p. 115.

applied to PCBs in the PP and the underlying FS at Portland Harbor,[84] even though the same exposure pathway (human consumption of fish and shellfish) is the most conservative health risk driving cleanup for both Portland Harbor and Lower Duwamish Waterway Superfund Sites.[85]

- Lower Passaic River Superfund Site: The ROD for the Lower Passaic River Superfund Site identifies highly toxic PTW at the 10^{-3} cancer risk for fish and crab consumption but does not specify the exact concentration.[86] However, the treatment of PTW material beyond that required for dredge material management at that site was determined not to be practicable or cost-effective.[87]

- General Electric-Pittsfield/Housatonic River Superfund Site, Rest of River Site: EPA indicated that PTW is present within the Housatonic River (Rest of River) because human health risks from fish consumption exceed 10^{-3},[88] but cites EPA PCB guidance[89] as a basis for declining to delineate PCB concentrations as PTW as *"no locations at which concentrations greater than 100 ppm occur on residential property."*[90] Additionally, EPA Region 1 references EPA contaminated sediment guidance[91] as further basis for not delineating PTW sediments for treatment, stating that:

  > *[A]lthough the NCP provides a preference for treatment for "principal threat waste," treatment has frequently not been selected for contaminated sediment... Based on available technology, treatment is not considered practicable at most sediment sites... [and] in situ containment can also be effective for [PTW],*

[84] EPA, 2016. Superfund Proposed Plan for the Portland Harbor Superfund Site, Multnomah County, Oregon, Superfund ID # ORSFN1002155, June 2016, p. 14; EPA, 2016. Portland Harbor RI/FS, Feasibility Study, Final, prepared by EPA and CDM Smith, June 2016, Table 3.2-1.

[85] EPA, 2014. Lower Duwamish Waterway ROD, prepared by EPA, November 2014, Table 19; EPA, 2016. Portland Harbor RI/FS, Feasibility Study, Final, prepared by EPA and CDM Smith, June 2016, Table 2.2-1a.

[86] EPA, 2016. Record of Decision, Lower 8.3 Miles of the Lower Passaic River, Part of the Diamond Alkali Superfund Site, Essex and Hudson Counties, New Jersey, prepared by EPA Region II, New York, New York, March 3, 2016, p. 79. Extrapolation of Table 24 in *Id.* suggests that the concentrations of PCBs considered to be PTW 4,000 µg/kg (56 fish meals annually), 6,600 µg/kg (34 crab meals annually), 18,800 µg/kg (12 fish or crab meals annually).

[87] *Id.*, p. 79.

[88] EPA, 2012. Regional Responses to the National Remedy Review Board Comments on the Site Information Package for the General Electric (GE)-Pittsfield/Housatonic River Project, Rest of River, DCN HR-080212-AARX, SDMS 518898, prepared by EPA New England Region, August 3, 2012, pp. 4-5.

[89] EPA, 1990. A Guide on Remedial Actions at Superfund Sites with PCB Contamination, Publication No. 9355.4-01FS.

[90] EPA, 2012. Regional Responses to the National Remedy Review Board Comments on the Site Information Package for the General Electric (GE)-Pittsfield/Housatonic River Project, Rest of River, DCN HR-080212-AARX, SDMS 518898, prepared by EPA New England Region, August 3, 2012, p. 5.

[91] USACE and EPA, 2000. A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, EPA 540-R-00-002, OSWER 9355.0-75, July 2000.

where that approach represents the best balance of the NCP nine remedy selection criteria. . . . . EPA's Contaminated Sediment Remediation Guidance for Hazardous Waste Sites (EPA, 2005) states that although the NCP provides a preference for treatment for "principal threat waste," treatment has frequently not been selected for contaminated sediment. High costs, uncertain effectiveness, and/or community preferences (for on-site operations) are factors that lead to treatment being selected infrequently at sediment site[sic] . . . Also, [i]t should be recognized that in-situ containment can also be effective for principal threat wastes, where that approach represents the best balance of the NCP nine remedy selection criteria.[92]

- Grasse River Superfund Site: The ROD for the Grasse River Superfund Site states: *"EPA does not believe that treatment of the principal threat wastes is practicable or cost effective given the widespread nature of the sediment contamination and the high volume of sediment that would need to be addressed."*[93]

Specific to the SI SDU, the physical stability of sediments in the SI SDU indicates the permanence of MNR or in-place remedial technologies such as capping and ENR are comparable to dredging (i.e., removal technologies). Long-term sediment stability in the SI SDU is indicated by multiple factors documented in the FS:[94]

1. Low current velocities measured in the lagoon;
2. The fine-grained nature of surface sediments; and
3. Net accumulation of sediments at the downstream portion of the lagoon.

As such, EPA should acknowledge in the PP and ROD that PTW within the SI SDU can be reliably contained and allow for the application of a wider range of remedial technologies. PTW in sediments should also be defined based on EPA and NCP guidance and should not arbitrarily be set at 200 μg/kg, a level that is based on a flawed analysis as discussed above. EPA's faulty categorization and analysis results in EPA placing label of "highly toxic PTW" on large areas and volumes of sediment with relatively low PCB concentrations that can be reliably contained or treated in-place. Re-evaluation of this issue will result in significant changes in the applicability of different remedial technologies for addressing sediments with PCB concentrations greater than

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[92] EPA, 2012. Regional Responses to the National Remedy Review Board Comments on the Site Information Package for the General Electric (GE)-Pittsfield/Housatonic River Project, Rest of River, DCN HR-080212-AARX, SDMS 518898, prepared by EPA New England Region, August 3, 2012, p. 5.

[93] EPA, 2013. Record of Decision, Grasse River Superfund Site, (a.k.a. Alcoa Aggregation Site), Massena, St. Lawrence County, New York, prepared by EPA Region 2, April 2013. p. 49.

[94] EPA, 2016. Portland Harbor RI/FS, Feasibility Study, Final, prepared by EPA and CDM Smith, June 2016, p. 3-13; Figure 2.2-1; Figure 3.4-20.

200 µg/kg in the SI SDU. This will include the application of capping and ENR to those areas EPA has designated as PTW.

6. Optimized Remedy Alternative for the SI SDU

For comparative purposes, TMG and BAE Systems – in conjunction with other PRPs associated with the SI SDU – have prepared an optimized conceptual remedy approach specific to the SI SDU which accounts for the above concerns (described in more detail in the Swan Island Group Comments).[95] Unlike EPA's preferred remedy Alternative I, this sediment decision unit-specific remedy accounts for the natural recovery observed within the SI SDU and incorporates this low-impact remedial option into the remedy design for the SI SDU. The updated SI SDU SWAC using all available data for PCBs in the surface sediments after completion of SI SDU-Optimized Remedy alternative is estimated to be 14 µg/kg. This updated SWAC in the SI SDU clearly indicates that MNR can be utilized as an in-place technology in combination with enhanced MNR (EMNR), dredging and capping to provide a permanent and protective remedy.

The proposed alternative remedy, as shown in Figure 5,[96] would involve a combination of dredging to a maximum of three feet, capping, applying broadcast granular activated carbon (GAC), EMNR, and MNR to address PCB contamination within the SI SDU. The dredging scheme would remove the surface sediment with elevated PCB concentrations while allowing for the placement of a cap, reactive residual layer, residual layer, or backfill without impeding the FMD requirements within the SI SDU. The containment of deeper sediment with contaminants at higher levels would provide a clean biologically active zone, would be resistant to propwash, and would be stable under the low intensity hydrodynamic conditions found in the SI SDU. In areas without dredging requirements, capping, applying broadcast GAC, or EMNR would be used to treat or contain contaminated sediments. Outside of the designated remedial action level boundary, this optimized remedy alternative would involve placement of an ENR cover consisting of a one-foot sand cover with a granular activated carbon amendment or the treatment of sediment through MNR. A summary comparison of EPA's Alternative I and the SI SDU-Optimized Remedy are provided below in Table 5.

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[95] Swan Island Group, 2016. Portland Harbor Superfund Site, Swan Island SDU Optimized Remedial Alternative, submitted to EPA Region 10. September 6, 2016.
[96] Figure 5 of these comments is a copy of Figure 5 from *Id.*

Table 5 – Remedy Comparison

Technology Application	EPA Proposed Plan - Alternative I	SI SDU-Optimized Remedy
Dredging (acres)	52	14
Capping (acres)	2	2
ENR/MNR (acres)	61	65
ENR + broadcast GAC (acres)	0	34
Estimated Cost ($)	$260M	$109M
Construction Duration (years)	6	3
Post-Remedy PCB SWAC (µg/kg)	16	14

Notes:

- Total undiscounted project costs presented in 2016 dollars (not adjusted for inflation).
- The post-remedy SWAC for Alternative E is derived from the EPA 2015 draft FS.[97] In the SI SDU, Alternative E is identical to Alternative I.
- Construction duration assumes use of one 1-10 CY dredge in the SI SDU.

CERCLA, the NCP, and EPA guidance all require that the selected remedial alternative be cost-effective.[98] To determine a remedy's cost-effectiveness, the overall remedy effectiveness must be evaluated in terms of short-term effectiveness, the long-term effectiveness, permanence, and reduction of toxicity, mobility, or volume through treatment.[99] The overall remedy effectiveness is then compared to cost to ensure that the remedy is cost-effective – that is, if its costs are proportional to its overall effectiveness.[100] However, when the costs and resultant risk reduction in the SI SDU for EPA's Alternative I and the SI SDU-Optimized Remedy are compared, EPA's Alternative I is not cost-effective. A factually supported, quantitative analysis of cost-effectiveness, based on measures of effectiveness that are consistent with the NCP, reveals that the increased cost of dredge-intensive remedies, including preferred Alternative I, is not proportional to increased effectiveness when compared with less costly alternatives.

Conclusion

These comments demonstrate that the selection of preferred Alternative I in the PP was the result of flawed analysis in a number of key respects. TMG and BAE Systems request that EPA fix these errors and perform a proper alternatives evaluation before issuing a ROD. Failure to do so would represent arbitrary and capricious action by the agency.

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[97] EPA, 2015. Portland Harbor RI/FS, Draft Final Feasibility Study Report, August 18, 2015, Table 4.2-1.

[98] 42 U.S.C. § 9621(a); 40 C.F.R.§ 300.430(f)(ii)(D); EPA, 1996. The Role of Cost in the Superfund Remedy Selection Process, 9200.3-23FS, September 1996.

[99] *Id.*

[100] *Id.*

Figure 1

TMG and BAE Systems Comments on the Proposed Plan

2014/2016 Sample ID	2014/2016 Total PCB (ppb)	LWG Total PCB (ppb)	LWG Sample ID
60	16	20	G696
62	609	983	G385
63	47	15	G425
64	49	2	G430
65	66	555	G421
66	224	75	G392
BAE-02	290	106	BT022
BAE-13	145	210	BT026
BAE-04	34	148	G364
BAE-10	301	380	G379
BAE-09	103	446	G382
BAE-12	423	2,310	G393
BAE-14	72	330	G397
BAE-15	66	679	G402
BAE-16	70	880	G415
BAE-17	62	159	NA-4B
BAE-19	51	116	PSY04
BAE-03	129	253	PSY18
BAE-00	964	43	PSY23
BAE-18	64	145	09R001
BAE-01	996	N/A	N/A
BAE-05	48	N/A	N/A
BAE-06	52	N/A	N/A
BAE-07	81	N/A	N/A
BAE-08	156	N/A	N/A
BAE-11	231	N/A	N/A

Legend

- Colocated Sample Location with LWG RI
- 2014 Kleinfelder Sample
- 2016 Geosyntec Sample
- Estimated EPA Remedial Alternative I Area

Outfalls
- Private
- City of Portland
- Port of Portland
- US Coast Guard

Notes:
1. Aerial imagery was taken in the summer of 2014 and downloaded from the City of Portland ArcGIS MapServer.
2. In the table, colored text denotes total PCB concentrations (ug/kg):
   Geosyntec Sample
   Kleinfelder Sample
   LWG RI Sample

Surface (0-30 cm) Sediment Sampling Results Portland, OR	Geosyntec consultants		Figure 1
500 250 0 500 Feet	Portland, OR	September 2016	

Figure 2

TMG and BAE Systems Comments on the Proposed Plan

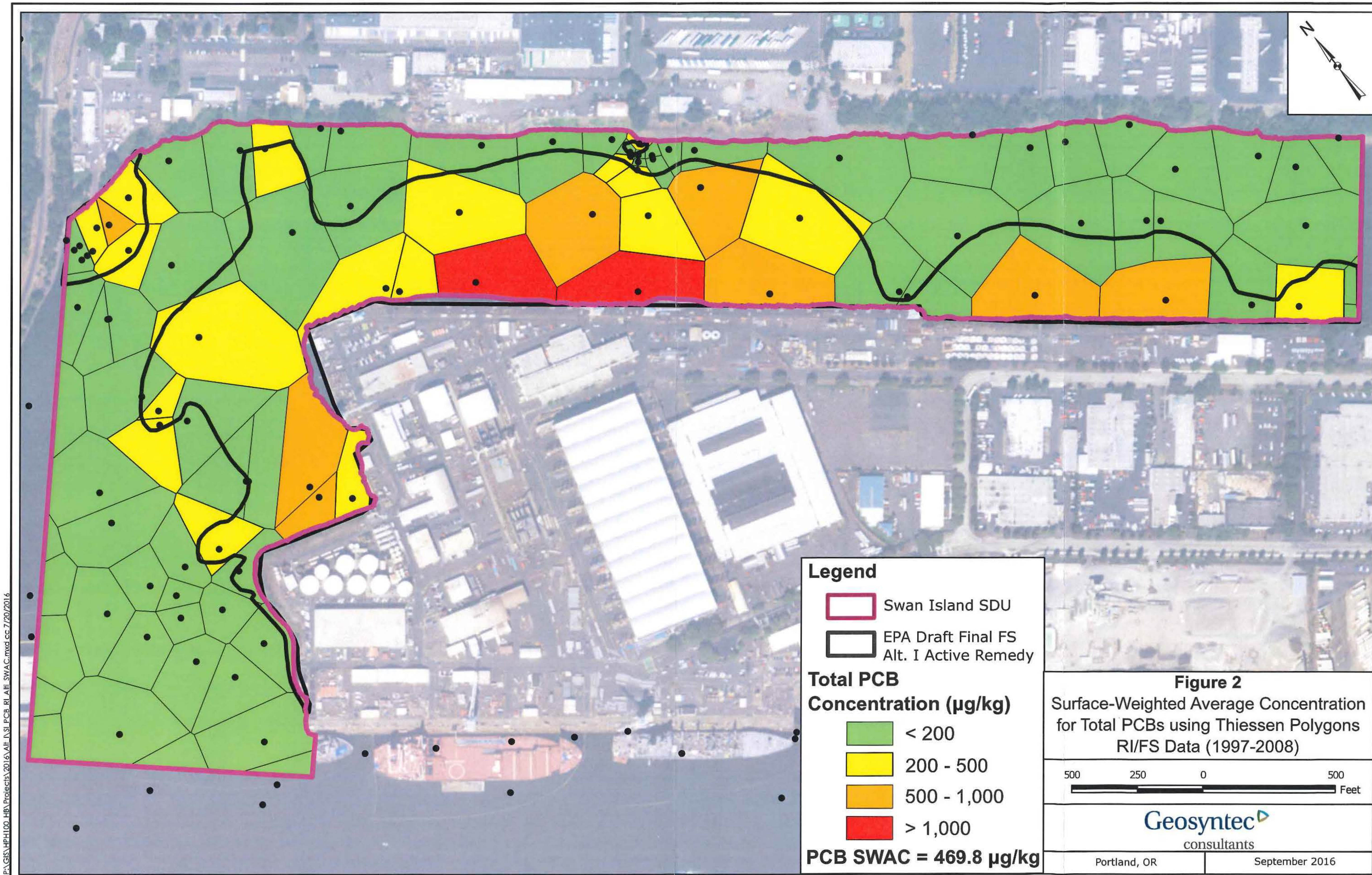


Figure 2
Surface-Weighted Average Concentration for Total PCBs using Thiessen Polygons RI/FS Data (1997-2008)

P:\GIS\HPH100_HB\Projects\2016\Att_I\SI_PCB_RI_Att_SWAC.mxd cc 7/20/2016

Figure 3

TMG and BAE Systems Comments

on the Proposed Plan

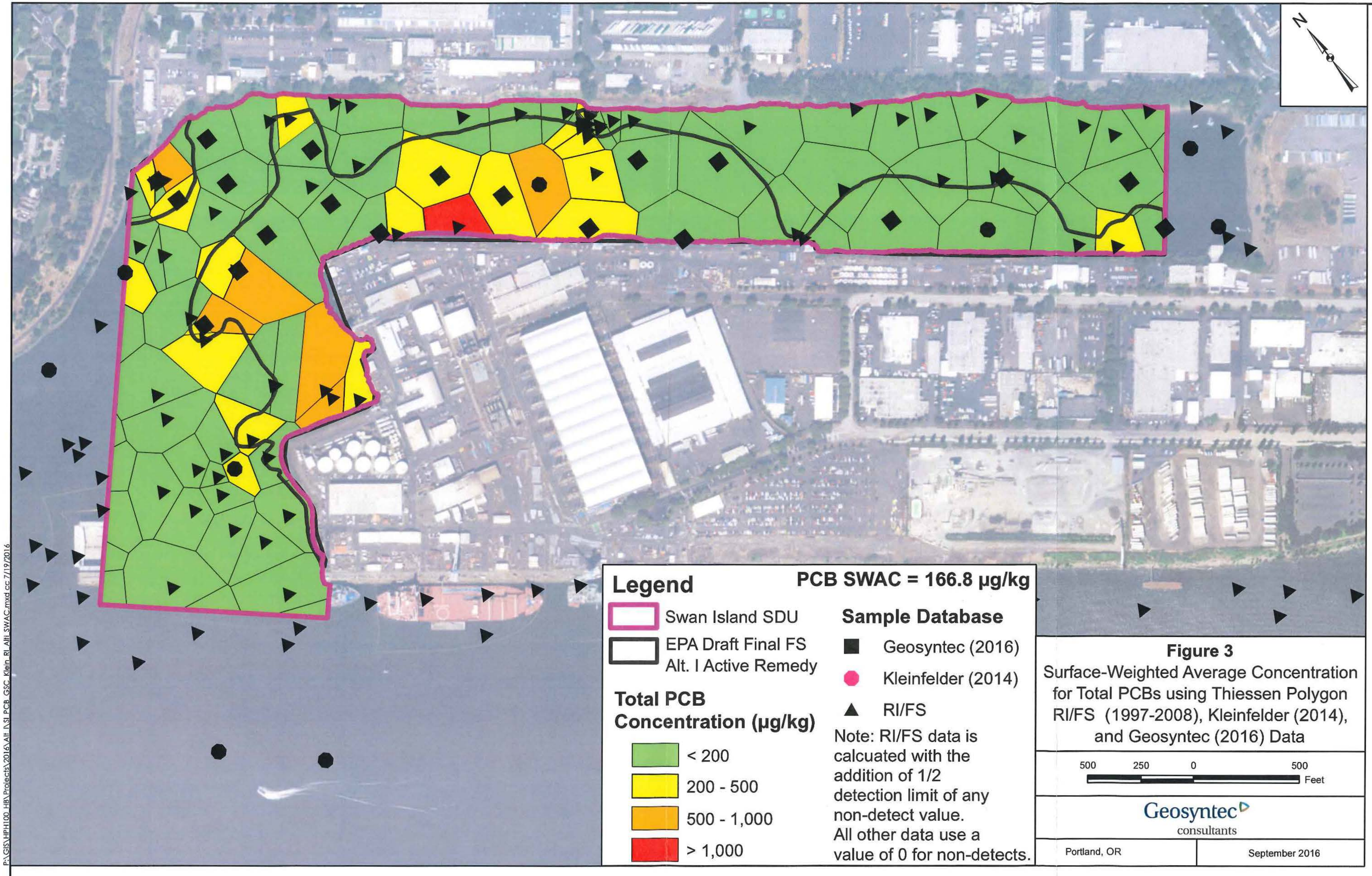
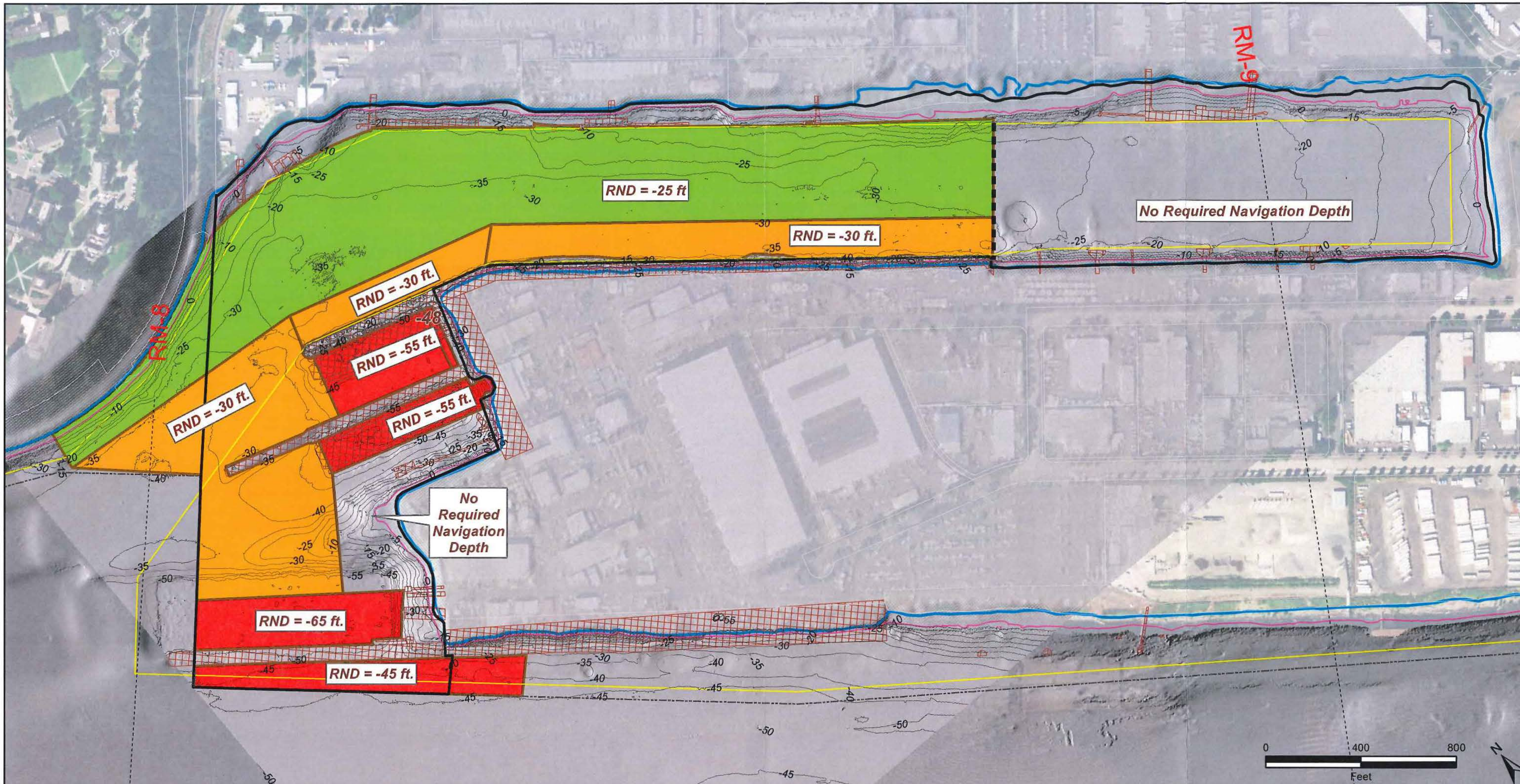


Figure 3
Surface-Weighted Average Concentration for Total PCBs using Thiessen Polygon RI/FS (1997-2008), Kleinfelder (2014), and Geosyntec (2016) Data

Figure 4

TMG and BAE Systems Comments on the Proposed Plan



- Merged Bathymetry (2015, 2009, 2004) CRD contour (5-ft)
- SDU
- Harborline
- Willamette River Federal Navigation Channel
- River Miles
- OLWL (6.9 NAVD88; 1.7 CRD [@T4])
- Waterfront Taxlots (2010)
- Dock Structures (LWG, 2007)
- OHWL (20.1 NAVD88; 14.9 CRD [@T4])

Required Navigation Depth (RND, 2016)

Required Navigation Depth Categories (RND, 2016)

- -20 to -25 ft
- -30 to -36 ft
- -45 to -65 ft

Notes:
- Based on Required Navigation Depths (RND, 2016)
- Merged Bathymetry (2015, 2009, 2004), 2014 Aerial Image
- "RND" = Required Navigation Depth

This more accurate FMD information should be incorporated into a revised FS and the ROD for the Site. Details will be updated during the remedial design phase, including the naviational needs of north shore business owners where shallower depths than currently shown may be sufficient to meet ongoing navigation requirements.

Figure 4

TMG and BAE Systems Comments

FIGURE 1

OVERWATER STRUCTURES AND UPDATED REQUIRED NAVIGATION DEPTH (SHOWN BY FACILITY), SWAN ISLAND SEDIMENT DECISION UNIT

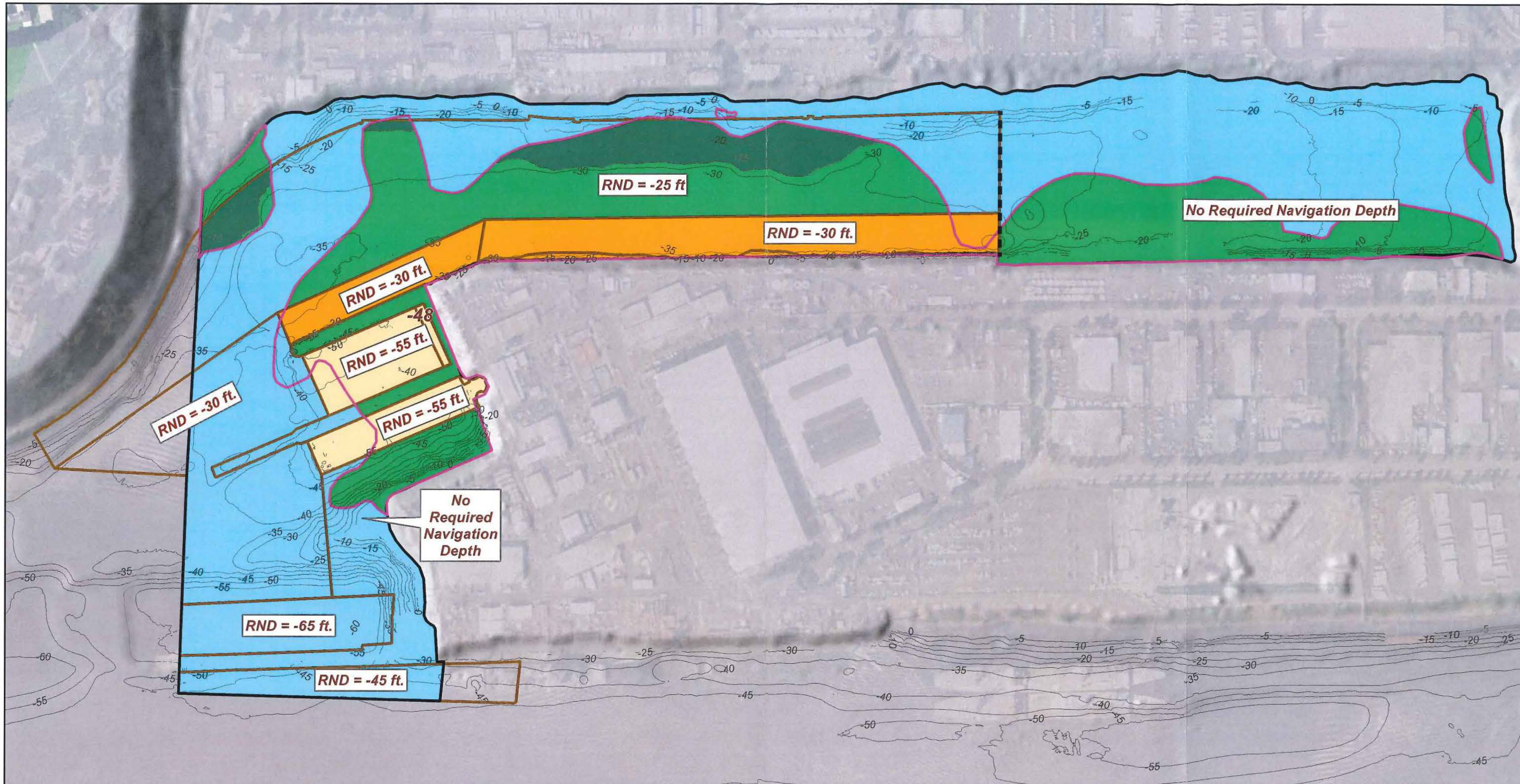
DATE: AUG 31, 2016	FORMATION ENVIRONMENTAL
BY: CRL/DLL	FOR: AKC

S:\GIS\tarcprj2010116\pltFS\Mtg_20160218_SIL_2009Bathy_OpDepths\Figures_20160825\Fig1_PotenFMDv2.mxd

Figure 5

TMG and BAE Systems Comments

on the Proposed Plan



2009 CRD contour (5-ft Index)
EPA Alternative I dredge footprint
Swan Island Sediment Decision Unit
2016 Potential FMD (Adapted from AQ_LWG_toEPA May, 2012)

Technology

- Dry Dock Basins: Dredge to Adequate Depth Below Required Navigation Depth, Residual Layer
- ENR / MNR (areas to be determined in design)
- Enhanced Natural Recovery (ENR) + Activated Carbon (AC)
- FMD Dredge + ENR + AC
- FMD Dredge + ENR + AC + Armoring

Notes:
- Based on Potential Future Maintenance (PFM) Dredge Depths (2016 updates). [Adapted from AQ LWG to EPA May, 2012]
- 2009 Bathymetry/Contours, 2014 Aerial Image
- "RND" = Required Navigation Depth

0 250 500 Feet

Figure 5
TMG and BAE Systems Comments

FIGURE 5

EXAMPLE
TECHNOLOGY ASSIGNMENTS
SWAN ISLAND SDU OPTIMIZED REMEDY

DATE: AUG 31, 2016
BY: CRL/DLL | FOR: MCL

FORMATION ENVIRONMENTAL

S:\GIS\arcprj2010116\pltFS\Mtg_20160218_SIL_2009Bathy_OpDepthsFigures_20160818\Fig5_SIL_OptRemedyTechMemo_20160817v3.mxd

Exhibit 1

Swan Island Sediment Decision Unit

TMG and BAE Systems 2016 PCB Sampling Report

Sediment Sampling Data Report

Swan Island Lagoon
Portland, Oregon

Prepared by:

Geosyntec consultants

engineers | scientists | innovators

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www.geosyntec.com

Project Number: HPH100E

August 12, 2016

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APPENDICES

1.0 EXECUTIVE SUMMARY

Geosyntec Consultants (Geosyntec) collected twenty surface sediment samples at Swan Island Lagoon in March 2016 to assess whether surface sediment concentrations of polychlorinated biphenyls (PCBs) had decreased through the natural recovery process in the Portland Harbor Superfund Site. Seventy-five percent of these samples show reduced PCB concentrations, with an average of 61% reduction, when compared with samples collected over a decade earlier by the Lower Willamette Group (LWG). These results also confirm trends seen with PCB concentrations found in surface sediment samples collected by Kleinfelder in 2014. Together, the Geosyntec and Kleinfelder sampling indicates that newly deposited sediments are covering and/or mixing with the older surface sediments both river-wide and in Swan Island Lagoon. As this recent data has not been incorporated in the EPA's Final Remedial Investigation (RI) (February 6, 2016), Feasibility Study (FS) (June 2016), or Proposed Plan (June 2016), the repeated characterization of Swan Island Lagoon by the EPA as an area where natural recovery is prohibitively slow-acting is not correct. These recent data show that the viability of monitored natural recovery within Swan Island Lagoon needs to be reassessed prior to the issuance of the Record of Decision (ROD), as the Proposed Plan specifically and incorrectly prohibits the selection of monitored natural recovery within the Swan Island Lagoon sediment decision unit. More holistically, these data demonstrate that natural processes occurring within the Willamette River are effectively and expeditiously reducing the risk posed to humans and the environment by PCBs in the Portland Harbor Superfund Site.

2.0 SEDIMENT SAMPLING DATA REPORT ORGANIZATION

This report presents the project objectives in Section 3, a brief history of Swan Island Lagoon and previous sediment investigations in Section 4, the sample collection and handling procedures in Section 5, the sampling analyses in Section 6, and the sampling results and analysis in Section 7. Conclusions are provided in Section 8. Supporting data and information are provided in tables and figures. The project-specific Sampling and Analysis Plan (SAP), Swan Island Lagoon Dye Tracer Model Simulations Technical Memorandum, surface sediment sample datasheets, laboratory analytical report, and data validation report are attached as appendices.

3.0 PROJECT OBJECTIVES

The objectives of the sediment sampling project are summarized below:

- Collocate surface sediment samples with previous studies to determine whether natural recovery of PCBs (i.e., PCB concentrations are decreasing) is occurring more rapidly in Swan Island Lagoon than previously projected by the EPA; and

- Determine whether or not upland source controls are sufficient within Swan Island Lagoon by assessing changes in surface sediment PCB concentrations.

As described in the 2016 Geosyntec SAP for Sediment Sampling (Appendix A), analytical and preparation methods were performed in accordance with:

- EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846), Third Edition, Update V (EPA 2014);
- Standard Methods for the Examination of Water and Wastewater, 22nd Edition (APHA, AWWA, and Water Environment Federation 2012); and
- ASTM International.

4.0 INTRODUCTION

Geosyntec conducted surface sediment sampling and chemical testing for PCB concentrations within Swan Island Lagoon to support the evaluation of natural recovery in the Portland Harbor Superfund Site by collocating sediment samples at locations previously sampled by the LWG for the Portland Harbor RI/FS and by Kleinfelder for the river-wide surface sediment evaluation program of natural recovery. The 2016 data is being used to supplement and update previous datasets that are between two years (Kleinfelder – 2014) and up to 18 years old (LWG – 1998-2007).

In this study, twenty surface sediment samples were collected in Swan Island Lagoon, analyzed for PCBs and compared to historical total PCB results from the collocated sample locations. Lower-than-previous PCB concentrations indicates that natural recovery processes (such as deposition of new sediment or the dispersion of contaminants) are actively occurring in Swan Island Lagoon combined with well-controlled upland contaminant sources connected to the Willamette River through private or City of Portland storm sewers. Our results, described in more detail below, found that 75% of samples had reduced PCB concentrations and demonstrate that natural recovery coupled with source control is actively occurring in Swan Island Lagoon.

4.1 Swan Island Lagoon Background

Swan Island Lagoon is an engineered lagoon located within the Portland Harbor Superfund Site which has been the location of industrial activities for nearly three-quarters of a century. Based on the EPA's 2016 FS and Proposed Plan, the key remedial risk driver in Swan Island Lagoon are PCBs, which are the only focused contaminant of concern (COC) identified by the EPA within the Swan Island sediment decision unit (EPA 2016a).

4.2 Previous Sediment Characterization Studies

Previous investigations conducted within the Portland Harbor Superfund Site and Swan Island Lagoon to assess sediment impacts from PCBs are summarized in the Kleinfelder Sediment SAP (Kleinfelder 2014a). Brief descriptions of these studies are provided below.

4.2.1 LWG RI/FS Study

Surface and subsurface sediment samples were collected by the LWG between 2002 and 2007 in the Lower Willamette River. In addition to this data, the RI/FS also utilized sediment samples which were collected and analyzed by parties other than the LWG dating back to 1998. The LWG reported elevated PCB concentrations on a harbor-wide basis in nearshore areas outside the Federal Navigational Channel and proximal to local known or suspected upland sources.

4.2.2 2014 Sediment Sampling at Portland Harbor

To address current PCB concentrations in surface sediments from the Portland Harbor study area and the upriver reach, Kleinfelder's study collected over 125 surface sediment samples between November 17 and December 3, 2014 (Kleinfelder 2015). Kleinfelder was commissioned by a group of parties to perform the sediment study. The results of the testing program were submitted to the EPA August 7, 2015. As described in the 2014 SAP, sediment sample locations were selected on a randomized grid to account for the range of PCB concentrations reported in previous studies including data used in the LWG RI/FS (Kleinfelder 2014a).

Of the 125 samples, only six locations were located within Swan Island Lagoon. Three of these samples showed a decrease in PCB concentrations compared to the RI/FS dataset, while three samples showed an increase in PCB concentrations compared to the RI/FS dataset. Two of the three samples with reduced PCB concentrations were located near repair and lay berths where Northwest Marine Ironworks operations are known to have occurred. The three Swan Island Lagoon samples with increased PCB concentrations were located near two City of Portland stormwater outfalls at the head of Swan Island Lagoon and near the Portland Shipyard dry docks and ballast water treatment plant, suggesting a potential lack of ongoing source control associated with current dry dock use.

Overall, results from the Kleinfelder study indicated that the concentrations of PCBs throughout the Portland Harbor Superfund Site in surface sediments are attenuating more rapidly than the EPA has estimated in the FS. More specifically, the Kleinfelder report concluded the following:

- A statistically significant decline in median total PCB concentrations in surface sediments of the Portland Harbor Superfund Site has occurred over the last 10 years;

- The decline in PCB concentrations has been relatively consistent over each river mile in the Portland Harbor Superfund Site and that natural recovery is occurring to a significant extent; and

- Substantial improvement in sediment quality has occurred and Portland Harbor is less contaminated than it was when samples were taken by the LWG during the RI/FS.

4.2.3 2016 EPA FS and Proposed Plan

EPA has incorrectly interpreted the natural recovery occurring at the Superfund Site which directly impacts the remedial design rules. In June 2016, the EPA released its FS and Proposed Plan for the Portland Harbor Superfund Site. The Proposed Plan presents the EPA's preferred cleanup alternative, Alternative I. Specifically, in regards to Swan Island Lagoon, the FS states that:

> "analysis of data collected during RI and information presented in the Draft FS (Anchor QEA 2012) indicate that monitored natural recovery (MNR) is not occurring in Swan Island Lagoon at a rate sufficient to reduce risks within an acceptable time frame. There is limited water circulation within Swan Island Lagoon, further limiting the rate of sediment deposition and clean upriver sediment from entering this area of the Site. Since MNR is not considered a viable

> technology in this area, capping, dredging, and enhanced natural recovery (ENR)[1] are considered for meeting the preliminary remediation goals (PRGs) in an acceptable time frame [...] Therefore, ENR is being considered for the area in Swan Island Lagoon that is outside the sediment management areas (SMAs) to reduce risks. Where principal threat waste (PTW) is identified, treatment technologies will be also be assigned" (EPA 2016b).

The Proposed Plan states that "a sufficient amount of capping/dredging in areas with higher contaminant concentrations is needed in Swan Island Lagoon" (EPA 2016c). As described above and based on the Proposed Plan, it is estimated that approximately 30% of site-wide dredging, 5% of site-wide capping, and 100% of site-wide ENR are projected to be necessary within the Swan Island Lagoon sediment decision unit. Notably absent is MNR, which is permitted in all areas of the Portland Harbor Superfund Site except Swan Island Lagoon.

The EPA uses six lines of evidence to evaluate the effectiveness of natural recovery in the FS and Proposed Plan: 1) change in elevation between the 2003 and 2009 bathymetric pairs; 2) consistency between multiple bathymetric pairs; 3) sediment grain size (percent fines); 4) anthropogenic factors (propwash areas); 5) surface to subsurface concentration ratio; and 6) wind and wake wave areas (EPA 2016a).

The selected remedial alternative for Swan Island Lagoon provided in the Proposed Plan is based upon the RI/FS data collected between 2002 and 2007 and does not take into account the subsequent sediment sampling data collected by Kleinfelder in 2014 and by Geosyntec in 2016 as described below. These data directly relate to the EPA lines of evidence numbers 3 (sediment grain size) and 5 (surface to subsurface concentration ratios), and as discussed in this report, suggest strongly that natural recovery is currently occurring in Swan Island Lagoon without the need for the placement of an enhancement layer cap. The EPA has repeatedly declined to include these more recent sediment data collected in 2014 and 2016 in its Proposed Plan, instead stating that these sediment data will be considered after completion of the ROD.

4.2.4 Hydrodynamic Studies

To better understand the transport potential of suspended particles in Swan Island Lagoon, a dye tracer modeling study (using Anchor QEA's EFDC model; LWG 2012)

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[1] ENR (also known as EMNR when combined with monitoring) is defined to be the placement of 12 inches of sand mixed with 5% activated carbon by volume, followed by periodic placement of replacement materials and sediment concentration monitoring.

was performed by Geosyntec in 2014 (Appendix B). Results from this analysis supports the conclusion that Swan Island Lagoon is a net depositional environment and indicate that MNR continues to occur in the Swan Island Lagoon. The main objective of the study was to better understand the transport potential of suspended particles (and potentially associated COCs) under various flow conditions. The dye tracer simulations were conducted during the low, medium, and high flow regimes and at dye release locations within Swan Island Lagoon and the opposite side of Swan Island along the Willamette River.

The results of the dye tracer studies indicate that dye concentrations and transport were most influenced by the type of flow regime at the time of release and the location of the dye release. Within the lagoon, the medium flow regime consistently simulated average concentrations which were 100 - 150 units higher than the low or high flow regimes. Overall, the temporal patterns for dye concentrations within Swan Island Lagoon were more similar between the low and high flow regimes, whereas those within the main stem of the Willamette River were more similar between the low and medium flow regimes. The similarities were due to the tidal cycle and magnitude of the Willamette River's flow, respectively. The flow within the main stem during the high flow regime was great enough to limit almost all transverse mixing, rapidly transporting dye particles along the northeast bank of the river instead.

Under all flow regimes and injection locations, the dye was transported downstream along the northeast bank of the Willamette River. The flow of the river limited the degree of local transverse mixing and dye was rarely transported beyond mid-channel. The largest differences between injection locations were whether the location was within the main stem of the river or Swan Island Lagoon itself. If the dye was injected into the main stem, it quickly transported downstream and out of the study area. However, if the dye was injected into Swan Island Lagoon, it exhibited a tendency to persist in small concentrations relative to the amount injected. The Model only simulated neutrally buoyant dye particles with no settling velocities. Therefore, the slow water velocities found within Swan Island Lagoon can temporarily or, in the case of particles with settling velocities, permanently trap introduced suspended particles.

Overall, the dye tracer model simulation further confirmed that Swan Island Lagoon is a depositional environment and more specifically:

- Dye releases into the lagoon tend to stay in the lagoon, with some mass lost to the Willamette River but a lingering plume in the lagoon. These results indicate the velocities are very low and tend to keep discharges of even light particles around. If the dye (sediment) particles were heavier, they would sink faster and remain in the lagoon.

- Dye releases in the main stem of the Willamette River tend to follow the east bank of the River closely and in some locations circulate around to spread into the lagoon. This further reinforces the concept that the lagoon receives sediments and water quality constituents from the main stem of the river, depending on where the discharges occur.

The results from this 2016 sediment study clearly show that PCB concentrations are decreasing throughout the lagoon suggesting that natural recovery processes are occurring. When compared to the dye tracer study, these results further invalidate the EPA's decision in the Proposed Plan to prohibit MNR as a viable remedial technology in Swan Island Lagoon.

5.0 SAMPLE COLLECTION AND HANDLING PROCEDURES

Surface sediment sampling was performed on March 4, 2016. A total of 20 surface (0 to 30 cm) sediment samples were collected within Swan Island Lagoon (Figure 1). This surface depth is consistent with the LWG and Kleinfelder's sample depths in Swan Island Lagoon. Fourteen of the 20 samples were collocated with LWG samples (Table 1). The additional six samples not collocated with LWG samples are located near the mouth of Swan Island Lagoon and were added to assess deposition in Swan Island Lagoon based on our review of Anchor QEA's EFDC model. Further details on sample collection and handling procedures are provided in the 2016 Geosyntec SAP (Appendix A).

Field sample logs and forms were completed and include descriptions of the sediment texture and color; sample penetration depth and quantity recovered; water depth, sediment surface disturbance, and presence of debris (Appendix C).

6.0 SAMPLING ANALYSIS

Surface sediment samples were analyzed for PCBs/Aroclors (EPA Method 8082A), Total Organic Carbon (TOC) (SM 5310B-modified), and grain size (ASTM D422-modified). The duplicated samples (SIL-20 and SIL-21) were analyzed for PCBs/Aroclors only. The laboratory analytical reports and chain of custody documents are provided in Appendix D.

A Stage 2A data validation review of laboratory analytical data was completed on April 8, 2016 (Appendix E). The data validation review confirmed the data are usable for meeting project objectives.

6.1 Total PCB Calculations

The Aroclor concentrations in each sample were summed to generate a measure of total PCB concentration at each sampling location (Table 2). The method for summing individual Aroclor concentrations within a given sample was consistent with the method used in previous investigations of sediment PCB concentrations in Swan Island Lagoon as follows:

- For each sample, concentrations reported for each Aroclor that were greater than the reporting limit were summed without adjustment;
- For each sample, concentrations reported for each Aroclor that were greater than the method detection limit (MDL) but less than the reporting limit (RL) were considered to be estimated concentrations, were qualified with a "J" flag, and were included in the total PCB sum for that sample without adjustment;
- For each sample, Aroclors that were reported as not detected (concentrations less than the MDL) in a given sample were not included in the calculation of total PCB if other Aroclors were reported at concentrations greater than the MDL in that sample; and
- For samples in which no Aroclors were present at a concentration greater than the MDL, the MDL in that sample was used as an estimate of the total PCB.

6.2 Grain Size Calculations

The percent of total sand and gravel was summed for each sample to generate the percent of total sand/gravel (0.063 mm to >2.00 mm). The percent of total silt and clay was summed for each sample to generate the percent of total silt/clay (<0.005 mm to 0.063 mm) (Table 3).

7.0 SAMPLING RESULTS

By collocating recent samples with the LWG RI/FS samples collected between 1998 and 2007, it is possible to assess the extent and magnitude of natural recovery processes within Swan Island Lagoon over the past decade, both in terms of PCB concentration and the sediment grain size, an indication of active sediment deposition. Of the 20 sample locations proposed in Swan Island Lagoon, 14 of these locations were collocated with LWG sample locations. Six of the 20 sample locations were new sample locations in Swan Island Lagoon (i.e., not sampled during previous investigations). These six sample locations were collected at the head of Swan Island Lagoon near the boundaries of the PTW PCB delineation[2] identified in previous draft FS maps. In addition to the 20 samples collected in 2016, Geosyntec also evaluated the six Swan Island Lagoon sample results from the 2014 Kleinfelder study which were also collocated with LWG RI/FS sample locations (Table 4).

7.1 Total PCB Concentrations

The total PCB concentration in the 20 sediment samples ranged from 34 µg/kg to 996 µg/kg with an average total PCB concentration of 209 µg/kg (Table 2). Of the 14 samples collected with LWG sample locations, 12 showed a decrease in total PCBs compared to the previous data and are generally located in the central and back portions of Swan Island Lagoon (Figure 2). The two collocated samples which showed increasing concentrations, SIL-00 and SIL-02, are both located at the mouth of Swan Island Lagoon in the dry dock basin and offshore of Coast Guard property, respectively.

Based on the LWG data, the 2016 EPA RI concluded that:

> "in Swan Island Lagoon, mean surface and subsurface total PCBs concentrations are approximately the same. The lack of a vertical gradient may reflect a combination of time-varying inputs, low net sedimentation rates, and localized high surface sediment mixing rates that result in variable spatial trends in sediment quality with depth" (EPA 2016a).

However, the data collected by Geosyntec demonstrate that mean surface concentrations have dropped substantially over the past decade of natural recovery, contradicting the EPA's characterization of Swan Island Lagoon as a location with similar surface and subsurface PCB concentrations. The highest percent increase was located at SIL-00 (2,142%), while the lowest percent decrease in total PCBs was located at SIL-16 (-92%).

The average total PCB concentration in Swan Island Lagoon surface sediments from the LWG RI/FS was 393 µg/kg and the average overall total PCB concentration in Swan

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[2] The PTW threshold for PCBs is based on the one-in-a-thousand cancer risk concentration of PCBs, and was determined by EPA to be 200 µg/kg. Note that this threshold is independent of the remedial alternative selected.

Island Lagoon surface sediments in 2014-2016 was 206 µg/kg. The average decrease in total PCB concentrations over time was 61%.

As described earlier in Section 4.2.2, three Swan Island Lagoon surface sediment samples from the Kleinfelder study showed decreases in total PCBs. These three samples were collected at the mouth of Swan Island Lagoon (Kleinfelder sample number 60), in the middle of the lagoon (Kleinfelder sample number 62), and at the head of the lagoon (Kleinfelder sample number 65) (Figure 1). There is good correspondence between the locations of samples with increased and decreased PCB concentrations between the Kleinfelder and Geosyntec studies, with most areas of Swan Island Lagoon showing decreased PCB concentrations except near the Portland Shipyard dry docks and City of Portland outfalls at the head of Swan Island Lagoon.

7.2 Grain Size, TOCs, and Percent Solids

Grain size was analyzed to evaluate trends in sediment surface processes related to transportation and disposition, with finer-grained sediment indicative of the deposition of new sediment. Grain size results are presented in Table 3. Percent silt/clays were typically higher near the mouth and head of the lagoon where City of Portland outfalls are located, suggesting deposition in these areas (Figure 3). These results suggest that sediment deposition is occurring in much of Swan Island Lagoon and that sediment conditions are favorable for natural recovery. These results confirm trends seen with the hydrodynamic dye tracer study conclusions. As previously discussed, the model found that the velocities are very low within the lagoon which promotes sediment deposition.

The average percent total silt/clay was 77.4%. The majority of samples were >80% silt/clay. Only three locations (SIL-03, SIL-04, and SIL-15) were predominately sand/gravel. SIL-03 was 52.2% sand/gravel and is located along the shoreline near the Coast Guard property. The total PCB concentration at SIL-03 was 129.0 µg/kg. SIL-04 was 90% sand/gravel and is located nearshore at the mouth of Swan Island Lagoon. The total PCB concentration at SIL-04 was 33.6 µg/kg (which was the lowest total PCB concentration measured during the 2016 Geosyntec study). SIL-15 was 97% sand/gravel and is located in the middle of Swan Island Lagoon near Portland Shipyard, Berth 304. The total PCB concentration at SIL-15 was 66.4 µg/kg.

TOC was reported in units of mg/kg wet weight and ranged from 7,500 mg/kg to 22,000 mg/kg with an average of 17,785 mg/kg (Table 3). Percent solids was reported in percent by weight and ranged from 30.4% by weight to 78.8% by weight with an average of 40.4% by weight (Table 3). Higher levels of total silt/clay were correlated with higher levels of TOC.

8.0 CONCLUSIONS

The 2016 sediment sampling results demonstrate that natural recovery is occurring within Swan Island Lagoon and that two of the key lines of evidence used by the EPA to prohibit the selection of MNR in the Swan Island Lagoon sediment decision unit are not supported by recent data. The PCB results for samples collected from Swan Island Lagoon demonstrate that surface sediment concentrations, and thus surface-to-depth PCB concentration ratios, have declined in Swan Island Lagoon compared to the dataset used by the EPA in its 2016 FS and Proposed Plan. Furthermore, grain size analysis of the sediment samples collected from Swan Island Lagoon demonstrate that fine-grained silts and clays are actively depositing within Swan Island Lagoon, which is a key indication of natural recovery.

The EPA's Proposed Plan currently has a rigid set of rules defining the remedy selection which specifically bar MNR as a remedial option in Swan Island Lagoon. The result of this inflexibility in the remedial selection means that if the new data collected by Geosyntec and Kleinfelder are not considered by the EPA prior to the issuance of the ROD, MNR will be preemptively and inappropriately prevented from being applied in the Swan Island Lagoon area despite current evidence to the contrary. If MNR is not permitted to be considered in the portions of Swan Island Lagoon where such a remedial approach is appropriate, the result would be a higher and ultimately unnecessary remedial cost increase singularly associated with remediation in Swan Island Lagoon.

9.0 REFERENCES

American Public Health Association (APHA), American Water Works Association (AWWA), and Water Environment Federation 2012. Standard Methods for the Examination of Water and Wastewater, 22nd Edition. January 5, 2012.

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Environmental Protection Agency (EPA) 2016b. Portland Harbor RI/FS Feasibility Study. June 2016.

Environmental Protection Agency (EPA) 2016c. Portland Harbor Superfund Site, Superfund Proposed Plan. June 2016.

Kleinfelder 2014a. Sediment Sampling and Analysis Plan, Portland Harbor Superfund Site, Portland, Oregon. November 7, 2014.

Kleinfelder 2014b. Quality Assurance Project Plan, Portland Harbor Superfund Site, Portland, Oregon. November 7, 2014.

Kleinfelder 2015. Sediment Sampling Data Report, Portland Harbor Superfund Site, Portland, Oregon. June 1, 2015.

Lower Willamette Group (LWG) 2012. Portland Harbor RI/FS Draft Feasibility Study. March 30, 2012.

FIGURES

2014/2016 Sample ID	2014/2016 Total PCB (ppb)	1998-2007 LWG Total PCB (ppb)	1998-2007 LWG Sample ID
60	16	20	G696
62	609	983	G385
63	47	15	G425
64	49	2	G430
65	66	555	G421
66	224	75	G392
SIL-02	290	106	BT022
SIL-13	145	210	BT026
SIL-04	34	148	G364
SIL-10	301	380	G379
SIL-09	103	446	G382
SIL-12	423	2,310	G393
SIL-14	72	330	G397
SIL-15	66	679	G402
SIL-16	70	880	G415
SIL-17	62	159	NA-4B
SIL-19	51	116	PSY04
SIL-03	129	253	PSY18
SIL-00	964	43	PSY23
SIL-18	64	145	09R001
SIL-01	996	N/A	N/A
SIL-05	48	N/A	N/A
SIL-06	52	N/A	N/A
SIL-07	81	N/A	N/A
SIL-08	156	N/A	N/A
SIL-11	231	N/A	N/A

Legend

- Colocated Sample Location with LWG RI/FS
- 2014 Kleinfelder Sample
- 2016 Geosyntec Sample
- Estimated EPA Remedial Alternative I Area

Outfalls

- Private
- City of Portland
- Port of Portland
- US Coast Guard

Notes:

1. Aerial imagery was taken in the summer of 2014 and downloaded from the City of Portland ArcGIS MapServer.
2. In the table, colored text denotes total PCB concentrations (ug/kg):
   Geosyntec Sample
   Kleinfelder Sample
   LWG RI/FS Sample

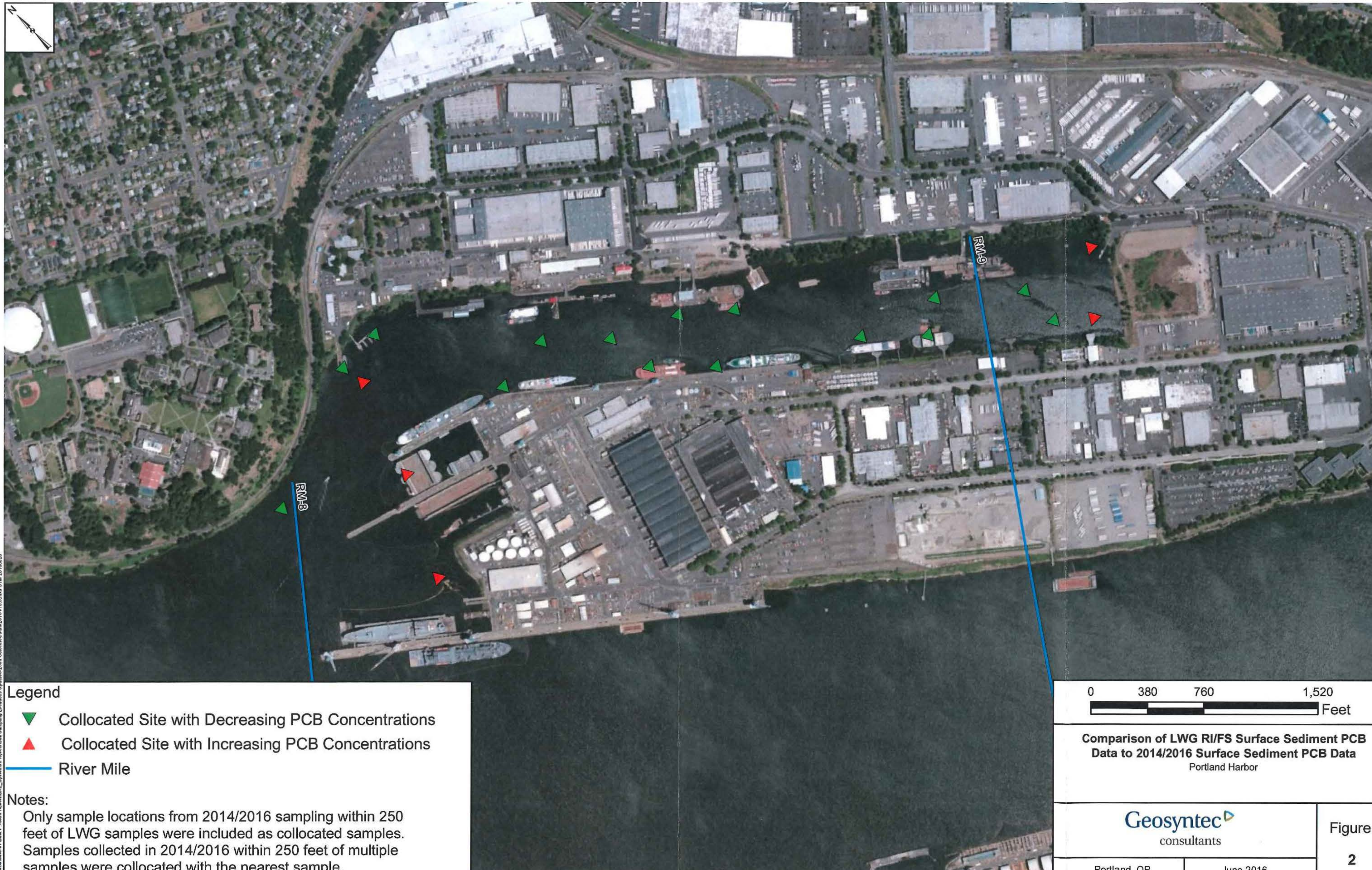
Surface (0-30 cm) Sediment Sampling Results
Portland, OR

500 250 0 500 Feet

Geosyntec consultants

Portland, OR | August 2016

Figure 1



Legend

▼ Collocated Site with Decreasing PCB Concentrations

▲ Collocated Site with Increasing PCB Concentrations

River Mile

Notes:
Only sample locations from 2014/2016 sampling within 250 feet of LWG samples were included as collocated samples. Samples collected in 2014/2016 within 250 feet of multiple samples were collocated with the nearest sample.

0 380 760 1,520 Feet

Comparison of LWG RI/FS Surface Sediment PCB Data to 2014/2016 Surface Sediment PCB Data
Portland Harbor

Geosyntec consultants

Portland, OR | June 2016

Figure 2

Legend

- Sand/Gravel
- Silt/Clay
- 2016 Geosyntec Sample
- 2014 Kleinfelder Sample

Outfalls

- Private
- City of Portland - Stormwater
- Port of Portland
- US Coast Guard

Notes:

1. Aerial imagery was taken in the summer of 2014 and downloaded from the City of Portland ArcGIS MapServer.
2. Grain size percentages may not add up to 100.0% due to rounding.

Surface (0-30 cm) Sediment Sampling Grain Size Distribution Portland, OR 500 250 0 500 Feet	Geosyntec consultants	Figure 3
	Portland, OR / August 2016	

Geosyntec
consultants

TABLES

Table 1
Target and Actual Sediment Sample Locations and Depths

			Target Sample Location		Accepted Sample Location					
Sample Name	Collocated LWG RI Sample ID[a]	Date	Latitude	Longitude	Latitude	Longitude	Water Depth (ft)	Water Depth (ft-CRD)	Distance from Target (ft)	Comments
SIL-00	PSY23	3/4/2016	45.56843	-122.72417	45.56857	-122.72395	55.7	51.7	112.6	Offset due to boom. Second attempt.
SIL-01	N/A	3/4/2016	45.56887	-122.72284	45.56887	-122.72283	40.3	36.1	N/A	N/A
SIL-02	N/A	3/4/2016	45.57008	-122.72299	45.57007	-122.72295	34.6	30.6	N/A	N/A
SIL-03	PSY18	3/4/2016	45.57041	-122.72299	45.57043	-122.72304	26.3	22.4	150.4	N/A
SIL-04	G364	3/4/2016	45.57057	-122.72172	45.57048	-122.72184	12.7	9.1	57.5	Third attempt.
SIL-05	N/A	3/4/2016	45.56984	-122.72194	45.56986	-122.72204	40.3	36.8	N/A	N/A
SIL-06	N/A	3/4/2016	45.56906	-122.72191	45.56901	-122.72202	41.1	36.7	N/A	N/A
SIL-07	N/A	3/4/2016	45.56946	-122.72053	45.56955	-122.72041	36.8	33.3	N/A	N/A
SIL-08	N/A	3/4/2016	45.56883	-122.72073	45.56884	-122.72073	39.8	36.4	N/A	N/A
SIL-09	G382	3/4/2016	45.56815	-122.72028	45.56815	-122.72032	38.9	35.6	25.9	N/A
SIL-10	G379	3/4/2016	45.56833	-122.71874	45.56828	-122.71880	39.2	35.9	36.2	N/A
SIL-11	N/A	3/4/2016	45.56758	-122.71806	45.56758	-122.71809	39.9	36.7	N/A	N/A
SIL-12	G393	3/4/2016	45.56655	-122.71733	45.56657	-122.71718	39.0	35.8	22.9	Offset due to barge.
SIL-13	BT026	3/4/2016	45.56703	-122.71567	45.56690	-122.71571	31.6	28.5	54.1	Offset due to barge.
SIL-14	G397	3/4/2016	45.56615	-122.71476	45.56625	-122.71453	35.3	32.3	56.3	N/A
SIL-15	G402	3/4/2016	45.56571	-122.71579	45.56572	-122.71590	36.2	33.3	44.2	Second attempt.
SIL-16	G415	3/4/2016	45.56404	-122.71267	45.56429	-122.71262	30.0	27.3	89.5	Offset due to barge.
SIL-17	NA-4B	3/4/2016	45.56387	-122.71051	45.56387	-122.71051	28.8	26.1	14.9	N/A
SIL-18	N/A	3/4/2016	45.56208	-122.70867	45.56208	-122.70866	19.9	17.5	N/A	N/A
SIL-19	N/A	3/4/2016	45.56284	-122.70868	45.56284	-122.70868	22.8	20.2	N/A	N/A
060	G696	11/24/2014	45.569316	-122.72674	45.56932	-122.72673	N/A	31.5	1	N/A
062	G385	11/24/2014	45.567433	-122.71743	45.56743	-122.71742	N/A	31.1	3	N/A
063	G425	11/24/2014	45.562723	-122.70739	45.56272	-122.70739	N/A	11.2	1	N/A
064	G430	11/24/2014	45.561694	-122.70784	45.56169	-122.70785	N/A	7.3	3	N/A
065	G421	11/24/2014	45.563459	-122.71130	45.56345	-122.71130	N/A	19.7	2	N/A
066	G392	11/21/2014	45.566850	-122.72507	45.56684	-122.72508	N/A	17.0	4	N/A

Notes
ft, feet
LWG, Lower Willamette Group
RI, remedial investigation
N/A, not applicable
[a] Sample from the LWG RI collocated with the sample collected in 2016 and identified in the "Sample Name" column.

Table 2
Aroclor Concentrations and Calculation of Total PCB Concentrations in Surface Sediment Samples

Sample ID	Compound	Result (µg/kg)[a]	Data Qualifier
SIL-00	Aroclor 1016	<7.73	ND
SIL-00	Aroclor 1221	<7.73	ND
SIL-00	Aroclor 1232	<7.73	ND
SIL-00	Aroclor 1242	<7.73	ND
SIL-00	Aroclor 1248	<7.73	ND
SIL-00	**Aroclor 1254**	**784**	
SIL-00	**Aroclor 1260**	**180**	
SIL-00	Aroclor 1262	<7.73	ND
SIL-00	Aroclor 1268	<7.73	ND
SIL-00	**Total PCBs**	**964**	
SIL-01	Aroclor 1016	<7.20	ND
SIL-01	Aroclor 1221	<7.20	ND
SIL-01	Aroclor 1232	<7.20	ND
SIL-01	Aroclor 1242	<7.20	ND
SIL-01	Aroclor 1248	<7.20	ND
SIL-01	**Aroclor 1254**	**841**	
SIL-01	**Aroclor 1260**	**155**	
SIL-01	Aroclor 1262	<7.20	ND
SIL-01	Aroclor 1268	<7.20	ND
SIL-01	**Total PCBs**	**996**	
SIL-02	Aroclor 1016	<3.48	ND
SIL-02	Aroclor 1221	<3.48	ND
SIL-02	Aroclor 1232	<3.48	ND
SIL-02	Aroclor 1242	<3.48	ND
SIL-02	Aroclor 1248	<3.48	ND
SIL-02	**Aroclor 1254**	**192**	
SIL-02	**Aroclor 1260**	**98.4**	
SIL-02	Aroclor 1262	<3.48	ND
SIL-02	Aroclor 1268	<3.48	ND
SIL-02	**Total PCBs**	**290.4**	
SIL-03	Aroclor 1016	<3.39	ND
SIL-03	Aroclor 1221	<3.39	ND
SIL-03	Aroclor 1232	<3.39	ND
SIL-03	Aroclor 1242	<3.39	ND
SIL-03	Aroclor 1248	<3.39	ND
SIL-03	**Aroclor 1254**	**89.8**	
SIL-03	**Aroclor 1260**	**39.3**	
SIL-03	Aroclor 1262	<3.39	ND
SIL-03	Aroclor 1268	<3.39	ND
SIL-03	**Total PCBs**	**129.1**	

Table 2
Aroclor Concentrations and Calculation of Total PCB Concentrations in Surface Sediment Samples

Sample ID	Compound	Result (µg/kg)[a]	Data Qualifier
SIL-04	Aroclor 1016	<0.667	ND
SIL-04	Aroclor 1221	<0.667	ND
SIL-04	Aroclor 1232	<0.667	ND
SIL-04	Aroclor 1242	<0.667	ND
SIL-04	Aroclor 1248	<0.667	ND
SIL-04	**Aroclor 1254**	**24.7**	
SIL-04	**Aroclor 1260**	**8.91**	
SIL-04	Aroclor 1262	<0.667	ND
SIL-04	Aroclor 1268	<0.667	ND
SIL-04	**Total PCBs**	**33.61**	
SIL-05	Aroclor 1016	<0.695	ND
SIL-05	Aroclor 1221	<0.695	ND
SIL-05	Aroclor 1232	<0.695	ND
SIL-05	Aroclor 1242	<0.695	ND
SIL-05	Aroclor 1248	<0.695	ND
SIL-05	**Aroclor 1254**	**25.9**	
SIL-05	**Aroclor 1260**	**22.4**	
SIL-05	Aroclor 1262	<0.695	ND
SIL-05	Aroclor 1268	<0.695	ND
SIL-05	**Total PCBs**	**48.3**	
SIL-06	Aroclor 1016	<0.724	ND
SIL-06	Aroclor 1221	<0.724	ND
SIL-06	Aroclor 1232	<0.724	ND
SIL-06	Aroclor 1242	<0.724	ND
SIL-06	Aroclor 1248	<0.724	ND
SIL-06	**Aroclor 1254**	**29.2**	
SIL-06	**Aroclor 1260**	**22.7**	
SIL-06	Aroclor 1262	<0.724	ND
SIL-06	Aroclor 1268	<0.724	ND
SIL-06	**Total PCBs**	**51.9**	
SIL-07	Aroclor 1016	<0.698	ND
SIL-07	Aroclor 1221	<0.698	ND
SIL-07	Aroclor 1232	<0.698	ND
SIL-07	Aroclor 1242	<0.698	ND
SIL-07	Aroclor 1248	<0.698	ND
SIL-07	**Aroclor 1254**	**49.5**	
SIL-07	**Aroclor 1260**	**31.6**	
SIL-07	Aroclor 1262	<0.698	ND
SIL-07	Aroclor 1268	<0.698	ND
SIL-07	**Total PCBs**	**81.1**	

Table 2
Aroclor Concentrations and Calculation of Total PCB Concentrations in Surface Sediment Samples

Sample ID	Compound	Result (µg/kg)[a]	Data Qualifier
SIL-08	Aroclor 1016	<1.40	ND
SIL-08	Aroclor 1221	<1.40	ND
SIL-08	Aroclor 1232	<1.40	ND
SIL-08	Aroclor 1242	<1.40	ND
SIL-08	Aroclor 1248	<1.40	ND
SIL-08	**Aroclor 1254**	**93**	
SIL-08	**Aroclor 1260**	**62.7**	
SIL-08	Aroclor 1262	<1.40	ND
SIL-08	Aroclor 1268	<1.40	ND
SIL-08	**Total PCBs**	**155.7**	
SIL-09	Aroclor 1016	<0.703	ND
SIL-09	Aroclor 1221	<0.703	ND
SIL-09	Aroclor 1232	<0.703	ND
SIL-09	Aroclor 1242	<0.703	ND
SIL-09	Aroclor 1248	<0.703	ND
SIL-09	**Aroclor 1254**	**58.7**	
SIL-09	**Aroclor 1260**	**44.7**	
SIL-09	Aroclor 1262	<0.703	ND
SIL-09	Aroclor 1268	<0.703	ND
SIL-09	**Total PCBs**	**103.4**	
SIL-10	Aroclor 1016	<3.48	ND
SIL-10	Aroclor 1221	<3.48	ND
SIL-10	Aroclor 1232	<3.48	ND
SIL-10	Aroclor 1242	<3.48	ND
SIL-10	Aroclor 1248	<3.48	ND
SIL-10	**Aroclor 1254**	**190**	
SIL-10	**Aroclor 1260**	**111**	
SIL-10	Aroclor 1262	<3.48	ND
SIL-10	Aroclor 1268	<3.48	ND
SIL-10	**Total PCBs**	**301**	
SIL-11	Aroclor 1016	<2.13	ND
SIL-11	Aroclor 1221	<2.13	ND
SIL-11	Aroclor 1232	<2.13	ND
SIL-11	Aroclor 1242	<2.13	ND
SIL-11	Aroclor 1248	<2.13	ND
SIL-11	**Aroclor 1254**	**65.9**	
SIL-11	**Aroclor 1260**	**165**	
SIL-11	Aroclor 1262	<2.13	ND
SIL-11	Aroclor 1268	<2.13	ND
SIL-11	**Total PCBs**	**230.9**	

Table 2
Aroclor Concentrations and Calculation of Total PCB Concentrations in Surface Sediment Samples

Sample ID	Compound	Result (µg/kg)[a]	Data Qualifier
SIL-12	Aroclor 1016	<6.92	ND
SIL-12	Aroclor 1221	<6.92	ND
SIL-12	Aroclor 1232	<6.92	ND
SIL-12	Aroclor 1242	<6.92	ND
SIL-12	Aroclor 1248	<6.92	ND
SIL-12	**Aroclor 1254**	**193**	
SIL-12	**Aroclor 1260**	**230**	
SIL-12	Aroclor 1262	<6.92	ND
SIL-12	Aroclor 1268	<6.92	ND
SIL-12	**Total PCBs**	**423**	
SIL-13	Aroclor 1016	<0.691	ND
SIL-13	Aroclor 1221	<0.691	ND
SIL-13	Aroclor 1232	<0.691	ND
SIL-13	Aroclor 1242	<0.691	ND
SIL-13	Aroclor 1248	<0.691	ND
SIL-13	**Aroclor 1254**	**59.8**	
SIL-13	**Aroclor 1260**	**85.5**	
SIL-13	Aroclor 1262	<0.691	ND
SIL-13	Aroclor 1268	<0.691	ND
SIL-13	**Total PCBs**	**145.3**	
SIL-14	Aroclor 1016	<0.711	ND
SIL-14	Aroclor 1221	<0.711	ND
SIL-14	Aroclor 1232	<0.711	ND
SIL-14	Aroclor 1242	<0.711	ND
SIL-14	Aroclor 1248	<0.711	ND
SIL-14	**Aroclor 1254**	**25.7**	
SIL-14	**Aroclor 1260**	**46.6**	
SIL-14	Aroclor 1262	<0.711	ND
SIL-14	Aroclor 1268	<0.711	ND
SIL-14	**Total PCBs**	**72.3**	
SIL-15	Aroclor 1016	<0.590	ND
SIL-15	Aroclor 1221	<0.590	ND
SIL-15	Aroclor 1232	<0.590	ND
SIL-15	Aroclor 1242	<0.590	ND
SIL-15	Aroclor 1248	<0.590	ND
SIL-15	**Aroclor 1254**	**33.6**	
SIL-15	**Aroclor 1260**	**32.8**	
SIL-15	Aroclor 1262	<0.590	ND
SIL-15	Aroclor 1268	<0.590	ND
SIL-15	**Total PCBs**	**66.4**	

Table 2
Aroclor Concentrations and Calculation of Total PCB Concentrations in Surface Sediment Samples

Sample ID	Compound	Result (µg/kg)[a]	Data Qualifier
SIL-16	Aroclor 1016	<0.690	ND
SIL-16	Aroclor 1221	<0.690	ND
SIL-16	Aroclor 1232	<0.690	ND
SIL-16	Aroclor 1242	<0.690	ND
SIL-16	Aroclor 1248	<0.690	ND
SIL-16	**Aroclor 1254**	**25.7**	
SIL-16	**Aroclor 1260**	**44.1**	
SIL-16	Aroclor 1262	<0.690	ND
SIL-16	Aroclor 1268	<0.690	ND
SIL-16	**Total PCBs**	**69.8**	
SIL-17	Aroclor 1016	<0.722	ND
SIL-17	Aroclor 1221	<0.722	ND
SIL-17	Aroclor 1232	<0.722	ND
SIL-17	Aroclor 1242	<0.722	ND
SIL-17	Aroclor 1248	<0.722	ND
SIL-17	**Aroclor 1254**	**22.7**	
SIL-17	**Aroclor 1260**	**39.5**	
SIL-17	Aroclor 1262	<0.722	ND
SIL-17	Aroclor 1268	<0.722	ND
SIL-17	**Total PCBs**	**62.2**	
SIL-18	Aroclor 1016	<0.702	ND
SIL-18	Aroclor 1221	<0.702	ND
SIL-18	Aroclor 1232	<0.702	ND
SIL-18	Aroclor 1242	<0.702	ND
SIL-18	Aroclor 1248	<0.702	ND
SIL-18	**Aroclor 1254**	**25.8**	
SIL-18	**Aroclor 1260**	**38.3**	
SIL-18	Aroclor 1262	<0.702	ND
SIL-18	Aroclor 1268	<0.702	ND
SIL-18	**Total PCBs**	**64.1**	
SIL-19	Aroclor 1016	<1.02	ND
SIL-19	Aroclor 1221	<1.02	ND
SIL-19	Aroclor 1232	<1.02	ND
SIL-19	Aroclor 1242	<1.02	ND
SIL-19	Aroclor 1248	<1.02	ND
SIL-19	**Aroclor 1254**	**18**	
SIL-19	**Aroclor 1260**	**33.2**	
SIL-19	Aroclor 1262	<1.02	ND
SIL-19	Aroclor 1268	<1.02	ND
SIL-19	**Total PCBs**	**51.2**	

Table 2
Aroclor Concentrations and Calculation of Total PCB Concentrations in Surface Sediment Samples

Sample ID	Compound	Result (µg/kg)[a]	Data Qualifier
SIL-20 *	Aroclor 1016	<0.695	ND
SIL-20 *	Aroclor 1221	<0.695	ND
SIL-20 *	Aroclor 1232	<0.695	ND
SIL-20 *	Aroclor 1242	<0.695	ND
SIL-20 *	Aroclor 1248	<0.695	ND
SIL-20 *	**Aroclor 1254**	**27.8**	
SIL-20 *	**Aroclor 1260**	**38.1**	
SIL-20 *	Aroclor 1262	<0.695	ND
SIL-20 *	Aroclor 1268	<0.695	ND
SIL-20 *	**Total PCBs**	**65.9**	
SIL-21 **	Aroclor 1016	<3.43	ND
SIL-21 **	Aroclor 1221	<3.43	ND
SIL-21 **	Aroclor 1232	<3.43	ND
SIL-21 **	Aroclor 1242	<3.43	ND
SIL-21 **	Aroclor 1248	<3.43	ND
SIL-21 **	**Aroclor 1254**	**61.2**	
SIL-21 **	**Aroclor 1260**	**131**	
SIL-21 **	Aroclor 1262	<3.43	ND
SIL-21 **	Aroclor 1268	<3.43	ND
SIL-21 **	**Total PCBs**	**192.2**	

Notes

ND, not detected at or above the reporting limit

[a]The Aroclor concentrations in each sample were summed to generate a measure of total PCB concentration at each sampling location.

*SIL-20 is a duplicate for SIL-17.

**SIL-21 is a duplicate for SIL-13.

Table 3
Total Organic Carbon, Percent Solids, and Grain Size in Surface Sediment Samples

Sample ID	% Sand/Gravel (0.063 mm to > 2.00 mm)	% Silt/Clay (< 0.005 mm to 0.063 mm)	TOC (mg/kg)	% Solids (% by weight)
SIL-00	12.5	87.4	18,000	42.5
SIL-01	19.3	80.6	19,000	38.5
SIL-02	17.2	82.8	19,000	48.6
SIL-03	52.2	47.8	15,000	50.9
SIL-04	90.0	10.0	7,700	72.1
SIL-05	8.6	91.4	20,000	34.9
SIL-06	5.9	94.1	20,000	33.9
SIL-07	12.7	87.3	17,000	36.9
SIL-08	11.7	88.3	19,000	36.3
SIL-09	17.1	83.0	22,000	34.2
SIL-10	16.1	83.9	19,000	36.3
SIL-11	9.1	91.0	22,000	30.4
SIL-12	17.8	82.2	20,000	32.7
SIL-13	19.3	80.7	21,000	36.2
SIL-14	12.4	87.6	21,000	31.5
SIL-15	97.0	3.1	7,500	78.8
SIL-16	8.4	91.6	7,500	30.8
SIL-17	9.4	90.6	20,000	34.2
SIL-18	6.2	93.8	20,000	35.0
SIL-19	9.2	90.8	21,000	34.2

Notes
TOC, total organic carbon

Table 4
Comparison of LWG RI Surface Sediment Samples to 2014/2016 Surface Sediment Samples

LWG RI Sample ID	Date Sampled	LWG RI Total PCB Result (µg/kg)	2014/2016 Sample ID	Date Sampled	2014/2016 Total PCB Result (µg/kg)	% Change
G696	11/30/2007	20.0	060	11/24/2014	15.7	-22%
G385	10/29/2004	983.0	062	11/24/2014	609.4	-38%
G425	10/7/2004	14.9	063	11/24/2014	47.3	217%
G430	10/22/2004	2.4	064	11/24/2014	48.5	1930%
G421	9/9/2004	555.4	065	11/24/2014	65.7	-88%
G392	10/8/2004	74.5	066	11/21/2014	223.9	201%
BT022	12/8/2005	106.0	SIL-02	3/4/2016	290.4	174%
BT026	12/12/2005	210.0	SIL-13	3/4/2016	145.3	-31%
G364	10/8/2004	148.0	SIL-04	3/4/2016	33.6	-77%
G379	9/9/2004	380.0	SIL-10	3/4/2016	301.0	-21%
G382	10/8/2004	446.0	SIL-09	3/4/2016	103.4	-77%
G393	10/22/2004	2310.0	SIL-12	3/4/2016	423.0	-82%
G397	8/24/2004	330.0	SIL-14	3/4/2016	72.3	-78%
G402	9/9/2004	679.0	SIL-15	3/4/2016	66.4	-90%
G415	10/22/2004	880.0	SIL-16	3/4/2016	69.8	-92%
NA-4B	10/21/2004	159.0	SIL-17	3/4/2016	62.2	-61%
PSY04	4/5/1998	116.0	SIL-19	3/4/2016	51.0	-56%
PSY18	4/4/1998	253.0	SIL-03	3/4/2016	129.0	-49%
PSY23	4/5/1998	43.0	SIL-00	3/4/2016	964.0	2142%
09R001	10/24/2002	144.5	SIL-18	3/4/2016	64.1	-56%
N/A	N/A	N/A	SIL-01	3/4/2016	996	N/A
N/A	N/A	N/A	SIL-05	3/4/2016	48.3	N/A
N/A	N/A	N/A	SIL-06	3/4/2016	51.9	N/A
N/A	N/A	N/A	SIL-07	3/4/2016	81.1	N/A
N/A	N/A	N/A	SIL-08	3/4/2016	155.7	N/A
N/A	N/A	N/A	SIL-11	3/4/2016	230.9	N/A

Notes
N/A, not applicable

APPENDIX A

Sampling and Analysis Plan for Sediment Sampling

Sampling and Analysis Plan
Sediment Sampling

Swan Island Lagoon
Portland, Oregon

Prepared by:

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Project Number: HPH100E

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1.0 INTRODUCTION

In 2014, Geosyntec participated in a sediment sampling program sponsored by a small Remedial Group (Group) to evaluate natural recovery for polychlorinated biphenyls (PCBs) at the Portland Harbor Superfund site. The Group commissioned Kleinfelder to develop a Sampling and Analysis Plan (SAP), Quality Assurance Protection Plan (QAPP) and to execute the sediment sampling and chemical testing effort.

The Group's study collected over 125 surface sediment samples within the Superfund site between November 17 and December 3, 2014. Of the 125 samples, only six locations were located within Swan Island Lagoon (Figure 1). The results of the study indicate that the concentrations of PCBs throughout the Superfund site surface sediments are attenuating more rapidly than the Environmental Protection Agency (EPA) has estimated in their Feasibility Study (FS). In particular, three of the six Swan Island Lagoon samples had reduced concentration. The three Swan Island Lagoon samples that showed increased concentrations are near other known PCB source areas.

To build upon the Group's work in evaluating the use of monitored natural recovery and enhanced monitored natural recovery, additional sediment sampling is proposed to provide a more current and robust dataset within Swan Island Lagoon. The purpose of this SAP is to present the sampling approach and procedures that will be used to supplement the existing dataset within Swan Island Lagoon. To demonstrate that natural attenuation is ongoing, the objective of this study is to identify areas within Swan Island Lagoon that have been previously sampled from 2002-2007 during the Portland Harbor Remedial Investigation (RI) by the Lower Willamette Group (LWG 2012) and analyzed for PCBs.

Surface sediments will be collected and analyzed for PCBs in this study to compare to historical PCB results from the same locations in Swan Island Lagoon. If PCB concentrations are decreasing compared to past data, it can be assumed that sediment is depositing in Swan Island Lagoon.

As described in the Kleinfelder SAP and QAPP (Kleinfelder 2014a and 2014b), analytical and preparation methods will be performed in accordance with:

- EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846), Third Edition, Update V (EPA 2014);
- Standard Methods for the Examination of Water and Wastewater, 22nd Edition (APHA, AWWA, and Water Environment Federation 2012); and

- ASTM International.

1.1 Previous Sediment Characterization Studies

A number of previous investigations were conducted within the Portland Harbor Superfund site by various environmental consultants and the EPA to assess site conditions and remediation alternatives. These previous investigations are summarized in the Kleinfelder SAP (Kleinfelder 2014a). A brief description of the 2015 Group study performed in the Portland Harbor Superfund site is provided below.

1.1.1 2014 Sediment Sampling, Portland Harbor

To address current PCB concentrations in surface sediments from the Portland Harbor study area and the upriver reach, Kleinfelder's study collected over 125 surface sediment samples between November 17 and December 3, 2014 (Kleinfelder 2015). The results of the testing program were submitted to the EPA in August 2015. As described in the project SAP, sediment sample locations were selected on a randomized grid to account for the range of PCB concentrations reported in previous studies including data used in the LWG RI/FS performed between 2004 and 2007 (Kleinfelder 2014a).

To assess current PCB sediment concentrations in the context of historical concentrations, the results of the 2014 PCB sampling were compared to total PCB concentrations reported from investigations performed in the LWG RI/FS. The 2015 Kleinfelder report concluded the following:

- A statistically significant decline in median total PCB concentrations in surface sediments of the Portland Harbor site has occurred over the last 10 years;
- The decline in PCB concentrations has been relatively consistent over each river mile in the Portland Harbor site and that natural recovery is occurring to a significant extent; and
- Substantial improvement in sediment quality has occurred, and Portland Harbor is less contaminated than it was in over a decade ago.

1.2 Sampling and Analysis Plan Organization

This SAP presents the project objectives in Section 2 and the project team and responsibilities are presented in Section 3, followed by discussions of sample collection methods, handling procedures, physical and chemical analyses, and data evaluation procedures in Sections 4 through 6, respectively. Section 7 outlines the contents of the final sediment sampling report. Supporting information is provided in tables and figures. The QAPP developed by Kleinfelder for the Group Study will be followed for this sediment study (Kleinfelder 2014b).

2.0 PROJECT OBJECTIVES

The objectives of the sediment sampling project are summarized below:

- Collocate surface sediment samples with previous studies to determine whether natural recovery of PCBs (i.e., PCB concentrations are decreasing) is occurring more rapidly in Swan Island Lagoon than previously projected by the EPA; and
- Determine whether or not upland source controls are sufficient within Swan Island Lagoon by looking at changes in surface sediment PCB concentrations.

3.0 PROJECT TEAM AND RESPONSIBILITIES

This sediment characterization project will include: (1) project planning and coordination; (2) field sample collection; (3) chemical and physical analysis of sediment; (4) Quality Assurance/Quality Control (QA/QC) management; and (5) a final project report. Staffing and responsibilities for these tasks are outlined below.

3.1 Project Planning and Coordination

Mr. Keith Kroeger will be the overall project manager responsible for developing and completing the sampling program and for technical issues related to sampling and testing and preparation of the final project report. Mr. Howard Cumberland will be the Project Director responsible for providing senior technical review of all phases of the project.

3.2 Field Sample Collection

Mr. Kroeger will provide overall direction and supervision to the field sampling program including logistics, personnel assignments, and field operations. Mr. Kroeger will be responsible for ensuring accurate sample positioning; recording sample locations, depths, and identification; ensuring conformance to sampling and handling requirements, including field decontamination procedures; photographing, describing, and logging the samples; and maintaining chain of custody of the samples until they are delivered to the analytical laboratories. The Health and Safety Plan (HASP) developed by Kleinfelder for the Group Study will be followed for this SAP (Kleinfelder 2014c).

All personnel are required to review the HASP and understand the provisions, potential hazards, and required personal equipment.

3.3 Chemical and Physical Analyses of Sediment Samples

Ms. Alison Clements will be responsible for coordinating the chemical laboratory analyses of sediment samples. She will also instruct the laboratory to maintain required handling and analytical protocols, including detection limit requirements for sediment chemical analysis.

The Project Chemist at the analytical laboratory will be responsible for chemical analysis in accordance with the EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846), Third Edition, Update V (EPA 2014), Standard Methods for the Examination of Water and Wastewater, 22nd Edition, and ASTM International analytical testing protocols and other applicable QA/QC requirements. A written report of analytical results and QA/QC data will be prepared by the analytical laboratory and will be included as an appendix in the final report.

3.4 Quality Assurance/Quality Control Management

Ms. Julia Klens Caprio will serve as QA Manager for the sediment testing program. She will perform QA oversight for the laboratory program. She will stay fully informed of laboratory activities during sample preparation and analysis. She will review the laboratory analytical and QA/QC data to assure data are valid and procedures meet the required analytical QC limits.

3.5 Reporting

Ms. Alison Clements and Mr. Kroeger will be responsible for the preparation of the final project report documenting the sediment sampling activities, analytical results, and interpretation of the results. Mr. Cumberland will provide senior technical review of the final project report.

4.0 SAMPLE COLLECTION AND HANDLING PROCEDURES

A description of the sample collection and handling and chemical analysis procedures are detailed below. Further details on sample collection and handling procedures are provided in the Kleinfelder SAP and QAPP, respectively (Kleinfelder 2014a and 2014b).

4.1 Surface Sediment Sampling Scheme

A total of 20 surface sediment samples will be collected within Swan Island Lagoon (Figure 2). The sampling vessel will navigate to the sample location using the onboard navigation system and the sample location coordinates. A hydraulic winch system will be used to lower and raise the grab from the river bed. Once retrieved, the sample will be visually analyzed for acceptability. Overlying water will be siphoned from the acceptable sample and the sample material will be removed from the grab system. Field logs and forms will be completed and include descriptions of the sediment texture and color; sample penetration depth and quantity recovered; water depth, sediment surface disturbance, and presence of debris. Once debris are removed from the sediment sample, the sediment sample will be transferred to a stainless steel bowl to be homogenized. The samples will be placed in analytical method-specific containers. Table 1 presents the proposed sampling locations. Table 2 provides specifications for sample containers, sample volumes, and holding times.

4.2 Field Operations and Equipment

The sediment surface depth (0 to 30 cm) represents the biologically active horizon and is the basis for characterizing sediments for the sampling event. This surface depth is consistent with the 2014 Group's sample depth and LWG RI/FS sample depths in Swan Island Lagoon. For this reason, a 0.1-m^2 Van Veen grab sampler will be used for collecting surface sediments. Collecting surface sediment using a Van Veen grab sampler causes minimal disturbance to the surficial layer while providing sufficient capacity for collecting larger volumes of sediment.

The surface sampling method is consistent with the EPA Methods for Collection, Storage, and Manipulation of Sediment for Chemical and Toxicological Analyses: Technical Manual – Chapter 3 (EPA 2001).

After retrieval of the sediment sample, the acceptability of each sample will be assessed against sample acceptability criteria. A sample will be considered acceptable if the following criteria are met:

- Sampler is fully closed without obstruction or blocking of its mouth;
- Sample sediment does not touch the top of the sampler;
- Overlying water is present and relatively clear;
- Sampler has retrieved a minimum of 20 centimeters of sediment;
- No evidence of sample sediment loss; and
- No evidence of channeling or washout on the sample sediment surface.

Sediment samples not meeting these criteria will be rejected and sample collection will be repeated. If an acceptable sediment sample cannot be collected at the proposed location after two attempts, the location will be moved within a 200-foot radius of the target location, where two additional attempts will be made. The Field Supervisor will confirm all equipment is in good working order prior to initiating the sampling program.

Field Documentation. As samples are collected, logs and field notes of sediment sampling activities and observations will be maintained in a project notebook. Included in this documentation will be the following:

- Estimated elevation of each sediment sample;
- Positioning coordinates;
- Date and time of sampling;
- Field descriptions of the sediment;
- Log of sample identification and compositing scheme;
- Chronological occurrence of events during sampling operations; and
- Deviations from the specifications of this SAP.

4.3 Positioning

The object of the positioning procedure is to accurately determine the positions of all sampling locations within ±2 meters. This determination will be achieved by referencing each sampling location to the State Plan Coordinate System, Oregon North Zone and the Horizontal Datum: North American Datum of 1983 (NAD83) standard projection. Location information will be obtained using a global positioning system (GPS). Depths will be recorded to the nearest tenth of a foot.

The following parameters will be documented at each sampling location:

- Time and date;
- Horizontal location in state plane coordinates; and
- Water depth latitude and longitude.

These parameters will be measured using a combination of GPS and an electronic depth sounder. Positioning while sampling will be performed using the GPS sensor which is located directly above the load line for the hydraulic grab system. The GPS system will provide inputs to an electronic chart plotting system and will guide the vessel to sample locations and record fixes as each sample is taken.

4.4 Equipment Decontamination Procedures

Sediment sampling equipment that comes in direct contact with the sample will be decontaminated prior to use and between each sampling event. All hand work (e.g., using stainless steel spoons for mixing the samples and filling sample containers) will be conducted with disposable nitrile gloves, which will be rinsed with distilled water before and after handling each individual sample to prevent cross-contamination. Clean equipment will be stored in a manner to prevent recontamination. Sampling equipment will be decontaminated according to the following procedure:

- Rinse with site water;
- Wash with a scrub brush using Alconox soap and water solution;
- Rinse twice with distilled water;
- Rinse with deionized water; and
- Dilute rinse waters with site water and discard into the river.

4.5 Sample Containers and Volumes

For each of the surface sample locations, approximately 16 ounces of sediment will be collected for physical and chemical analysis of bulk sediment. See Table 2 for container and sample size information.

Each sample container will be clearly labeled with the project name and number, sample location identification, type of analysis requested, sampling date and time, preservative type (if applicable), name or initials of person(s) preparing the sample, and referenced by entry into the logbook. The 2014 Kleinfelder QAPP discusses sample containers and preservation techniques in further detail (Kleinfelder 2014b).

4.6 Sample Transport and Chain of Custody Procedures

Containerized sediment samples will be transported to the appropriate laboratory for further processing and testing. Sample transport procedures will be as follows:

- Individual sample containers will be packed to prevent breakage and transported in a sealed ice chest or other suitable container. A sufficient amount of ice will be used to maintain a temperature of 4°C +/- 2°C.

- Each cooler or container containing the sediment samples for analysis will be delivered to the laboratory within 24 hours of being sealed.
- The shipping containers will be clearly labeled with sufficient information (name of project, time and date container was sealed, person sealing the container, and consultant's office address) to enable positive identification.
- Glass jars will be separated in the shipping container by shock absorbent material (e.g., bubble wrap) to prevent breakage.
- Ice will be placed in separate plastic bags and sealed. A sufficient amount of ice will be used to maintain a temperature of 4°C +/- 2°C.
- A sealed envelope containing custody forms will be enclosed in a plastic bag and taped to the inside lid of the cooler.
- Signed and dated custody seals will be placed across the openings on all coolers prior to shipping.

Upon transfer of sample possession to the designated laboratory, the custody form will be signed by the person(s) transferring custody. Upon receipt of samples at the laboratory, the shipping container seal will be broken, and the condition of the samples will be recorded by the receiver. Custody forms will continue to be used to track sample handling, including inter-laboratory transfer of samples, and final disposition.

5.0 PHYSICAL AND CHEMICAL ANALYSIS

The holding times and volume and storage requirements for physical and chemical testing are summarized in Table 2. The analytical methods and detection limit goals for sediment analyses are compiled in Table 3.

The surface sediment samples will be analyzed for grain size (ASTM D422-modified), PCBs/Aroclors (EPA Method 8082A), and total organic carbon (TOC) (SM 5310B-modified).

5.1 <u>Quality Assurance/Quality Control</u>

The following QA/QC procedures will be implemented during the project to ensure sample integrity and data quality. The 2014 Kleinfelder QAPP discusses QA/QC objectives, organization, and functional activities associated with the site investigation in further detail (Kleinfelder 2014b).

5.1.1 Chain of Custody

A chain of custody record for each set of samples will be maintained during sample handling and transport and will accompany sample shipments to the analytical laboratories. The chain of custody information that will continue to be tracked at the analytical laboratory includes sample identification number, date and time of sample receipt, analytical parameters, location and conditions of storage, date and time of removal from and return to storage, signature of person removing and returning the sample, reason for removing from storage, and final disposition of the sample.

5.1.2 Limits of Detection

The surface sediment samples will be analyzed according to the test methods and detection limit goals identified in Table 3.

5.1.3 Sample Storage Requirements

The surface sediment samples for physical and chemical testing will be maintained at the testing laboratory in accordance with the sample holding limitations and storage requirements listed in Table 2. Twenty-two sediment samples, including two duplicate surface sediment samples, will be maintained under proper storage conditions until the chemistry data are deemed acceptable by the EPA.

5.1.4 Quality Assurance/Quality Control Samples

Quality Control spike samples including matrix spike (MS) and matrix spike duplicate (MSD), laboratory control sample (LCS) and laboratory control sample duplicate (LCSD) (or blank spike/blank spike duplicate, and surrogates) will be performed at the analytical laboratory, as specified in Table 3.

5.1.5 Laboratory Report

A written report will be prepared by the analytical laboratory documenting the following activities associated with the analysis of project samples:

- Analytical results of QA/QC samples;
- Protocols used during analyses;
- Chain of custody procedures, including explanation of any deviation from those identified herein;
- Any protocol deviations from the approved sampling plan; and
- Location and availability of data.

6.0 SEDIMENT CHEMISTRY DATA EVALUATION PROCEDURES

Of the 20 sample locations proposed in Swan Island Lagoon, 14 of these locations are collocated with LWG RI/FS sample locations. Six of the 20 sample locations proposed are new sample locations in Swan Island Lagoon (i.e., not sampled during previous investigations). These six sample locations are proposed at the head of Swan Island Lagoon in areas that show a stronger tendency for deposition. Additionally, the six Swan Island Lagoon sample results from the 2014 Group study will also be included in the overall evaluation.

Sediment PCB concentrations detected in the sediment samples will be compared to the collocated LWG RI/FS data. If PCB concentrations are lower than the LWG RI/FS concentrations, it can be assumed that newly deposited sediments are covering the bedded sediments and reducing the overall risk to biological receptors. This line of evidence would demonstrate that newly deposited sediments are covering the bedded sediments and reducing the overall risk to biological receptors. If PCB concentrations are higher than the corresponding LWG RI/FS concentrations, there may be an ongoing PCB source within the Swan Island Lagoon. Sources could include private and City storm sewer outfalls discharging to Swan Island Lagoon, ongoing Shipyard activities, and/or sediments contaminated with PCBs being transported from outside the Swan Island Lagoon in the main stem of the River and depositing in the Swan Island Lagoon.

This evidence could be presented to the EPA, prior to development of the Site Conceptual Remedy, in an effort to encourage them to quantify and evaluate the ongoing effects of natural recovery within Swan Island Lagoon and the viability of monitored natural recovery as a component of the FS's active remedial alternatives.

7.0 REPORTING

A sediment characterization report documenting all activities associated with collection, sample handling and shipping, and physical and chemical analyses will be prepared. The chemical testing report from the analytical laboratory (including raw data) will be included as an appendix. At a minimum, the following will be included in the final report:

- Type of sampling equipment used;
- Protocols and procedures used during sampling and testing and an explanation of any deviations from the sampling plan protocols;
- Descriptions of each sample;

- Methods used to locate the sampling positions within an accuracy of ±2 meters;
- Maps and tables identifying locations where the sediment samples were collected and reported in easting and northing to the nearest tenth of a foot on State Plane Coordinates and NAD83 coordinates in latitude and longitude;
- Chain of custody procedures used, and explanation of any deviations from the sampling plan procedures;
- Tabular summary of chemical testing results compared to LWG RI/FS data; and
- Interpretation of the results to assist in estimating the projected remedy costs.

8.0 REFERENCES

American Public Health Association (APHA), American Water Works Association (AWWA), and Water Environment Federation 2012. Standard Methods for the Examination of Water and Wastewater, 22nd Edition. January 5, 2012.

Environmental Protection Agency (EPA) 2001. EPA Methods for Collection, Storage, and Manipulation of Sediment for Chemical and Toxicological Analyses: Technical Manual. Office of Water. EPA 823-B-01-002.

Environmental Protection Agency (EPA) 2014. Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods. U.S. EPA SW-846, Third Edition. Update V. July 2014.

Kleinfelder 2014a. Sediment Sampling and Analysis Plan, Portland Harbor Superfund Site, Portland, Oregon. November 7, 2014.

Kleinfelder 2014b. Quality Assurance Project Plan, Portland Harbor Superfund Site, Portland, Oregon. November 7, 2014.

Kleinfelder 2014c. Sediment Sampling and Analysis Health and Safety Plan, Portland Harbor Superfund Site, Portland, Oregon. October 31, 2014.

Kleinfelder 2015. Sediment Sampling Data Report, Portland Harbor Superfund Site, Portland, Oregon. June 1, 2015.

Lower Willamette Group (LWG) 2012. Draft Portland Harbor Feasibility Study. March 2012.

FIGURES

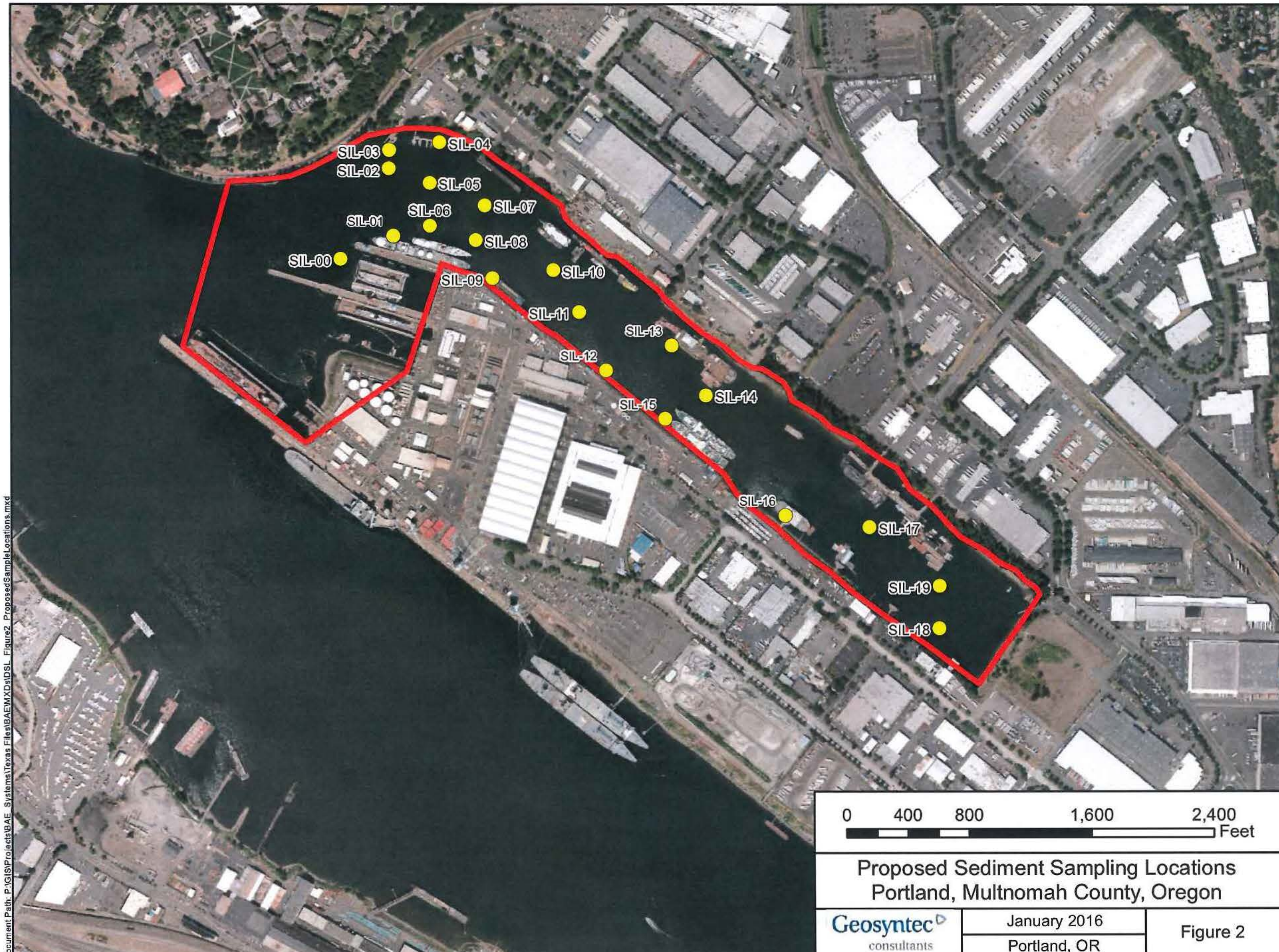
Site Location
Portland, Multnomah County, Oregon

January 2016
San Antonio, Texas

Figure 1

Document Path: C:\GIS_Temp\BAE\MXDs\DSL_Figure1_SiteLocation.mxd

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



Proposed Sediment Sampling Locations
Portland, Multnomah County, Oregon

Geosyntec consultants | January 2016 | Portland, OR | Figure 2

Document Path: P:\GIS\Projects\BAE_Systems\Texas Files\BAE\MXDs\DSL_Figure2_ProposedSampleLocations.mxd

Service Layer Credits: City of Portland

TABLES

Table 1
Proposed Sample Locations

Proposed Sample Identification	Latitude	Longitude
SIL-00	45.56843	-122.72417
SIL-01	45.56887	-122.72284
SIL-02	45.57008	-122.72299
SIL-03	45.57041	-122.72299
SIL-04	45.57057	-122.72172
SIL-05	45.56984	-122.72194
SIL-06	45.56906	-122.72191
SIL-07	45.56946	-122.72053
SIL-08	45.56883	-122.72073
SIL-09	45.56815	-122.72028
SIL-10	45.56833	-122.71874
SIL-11	45.56758	-122.71806
SIL-12	45.56655	-122.71733
SIL-13	45.56703	-122.71567
SIL-14	45.56615	-122.71476
SIL-15	45.56571	-122.71579
SIL-16	45.56404	-122.71267
SIL-17	45.56387	-122.71051
SIL-18	45.56208	-122.70867
SIL-19	45.56284	-122.70868

Table 2
Sample Storage Criteria

Sample Type	Analytical Holding Time	Preservation Temperature	Container Size
Grain Size	Not applicable	Ambient temperature	8-oz glass jar
Total Organic Carbon	14 days for analysis	Cool to ≤ 6°C, not frozen	8-oz glass jar
PCBs	14 days for extraction 40 days after extraction for analysis	Cool to ≤ 6°C, not frozen	8-oz glass jar

Table 3
Analyte List, Quantitation Limits, Precision, and Accuracy Criteria for Sediment

Analytes	Analytical Method	Reporting Limit	MDL	MS/MSD (%R)	MS/MSD (RPD)	LCS/LCSD (%R)	LCS/LCSD (RPD)
PCBs (µg/kg)							
Aroclor 1016	U.S. EPA Method 8082A	1.33	0.67	47-134	30	47-134	30
Aroclor 1221	U.S. EPA Method 8082A	1.33	0.67	-	-	-	-
Aroclor 1232	U.S. EPA Method 8082A	1.33	0.67	-	-	-	-
Aroclor 1242	U.S. EPA Method 8082A	1.33	0.67	-	-	-	-
Aroclor 1248	U.S. EPA Method 8082A	1.33	0.67	-	-	-	-
Aroclor 1254	U.S. EPA Method 8082A	1.33	0.67	-	-	-	-
Aroclor 1260	U.S. EPA Method 8082A	1.33	0.67	47-134	30	47-134	30
Aroclor 1262	U.S. EPA Method 8082A	1.33	0.67	-	-	-	-
Aroclor 1268	U.S. EPA Method 8082A	1.33	0.67	-	-	-	-
DCBP (surrogate)	U.S. EPA Method 8082A	-	-	44-111	-	-	-
Conventional Parameters							
Gravel (>2.0 mm)	ASTM D 422m	% of Total	-	-	-	-	-
Sand (0.063 mm - 2.00 mm)	ASTM D 422m	% of Total	-	-	-	-	-
Silt (0.005 mm < 0.063 mm)	ASTM D 422m	% of Total	-	-	-	-	-
Clay (<0.005 mm)	ASTM D 422m	% of Total	-	-	-	-	-
Percent Retained 4.75 mm sieve (#4)	ASTM D 422m	% of Total	-	-	-	-	-
Percent Retained 2.00 mm sieve (#10)	ASTM D 422m	% of Total	-	-	-	-	-
Percent Retained 0.85 mm sieve (#20)	ASTM D 422m	% of Total	-	-	-	-	-
Percent Retained 0.425 mm sieve (#40)	ASTM D 422m	% of Total	-	-	-	-	-
Percent Retained 0.250 mm sieve (#60)	ASTM D 422m	% of Total	-	-	-	-	-
Percent Retained 0.150 mm sieve (#100)	ASTM D 422m	% of Total	-	-	-	-	-
Percent Retained 0.106 mm sieve (#140)	ASTM D 422m	% of Total	-	-	-	-	-
Percent Retained 0.075 mm sieve (#200)	ASTM D 422m	% of Total	-	-	-	-	-
Percent Retained 0.063 mm sieve (#230)	ASTM D 422m	% of Total	-	-	-	-	-
Total Organic Carbon (mg/kg)	SM5310B MOD	200	100	-	-	85-115	20

Notes

DBCP = decachlorobiphenyl, surrogate for U.S. EPA Method 8082A included in all samples (laboratory and field)
%R = percent recovery
RPD = relative percent difference

APPENDIX B

Technical Memorandum, Dye Tracer Model Simulations

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Technical Memorandum

Dye Tracer Model Simulations

Date: 29 December 2014

To: Howard Cumberland, and Scott Rowlands, Geosyntec Consultants

From: Rob Annear, Paul Hobson, and Brian Apple, Geosyntec Consultants

Subject: Geosyntec Project: HPH100B, Hydrodynamic Model, Task 3

EXECUTIVE SUMMARY

In order to better understand the transport potential of suspended particles in the Swan Island Lagoon (Lagoon), a particle tracking analysis was performed using the AQ-EFDC model (Model). The Model was used to simulate neutrally buoyant dye tracer particles with no settling velocities. A previous analysis into the depositional nature of the Lagoon estimated the average water velocities were approximately 0.0030 m/s within the Lagoon (Annear et al., 2014). These slow water velocities can temporarily or, in the case of particles with higher settling velocities, more permanently trap introduced suspended particles. The water velocities within the Lagoon were estimated to be greater during the flood tide rather than the ebb tide, which would suggest a greater propensity for the Lagoon to move suspended particles to the head of the Lagoon and deposit along the way (Annear et al., 2014).

The dye particle tracking analysis consisted of using the Model for two types of simulation scenarios: comparing particle transport between low, medium, and high flow regimes when the dye is introduced at the same location within the Lagoon, and comparing the dye transport when the dye is introduced at different locations in and around the Lagoon under the medium flow regime.

Under the various flow regimes, the dye was transported downstream along the northeast bank of the Willamette River (River). Transverse mixing was very limited within the main stem of the Willamette River due to the increased river flow water velocities, particularly during the high flow regime. The mixed semidiurnal tidal cycle has a noticeable effect on the hydrodynamics and, as a result, the transport of the dye within the Lagoon and the main stem River. During periods when the two high and low tides of the tidal cycle are approximately the same size, the water levels within the Lagoon do not fluctuate greatly and there is a delay in the transport of dye

within the Lagoon. When the two daily high and low tides are of markedly different sizes, the transport of dye was accelerated to the head or entrance of the Lagoon, respectively. However, under the various flow regimes, the dye concentration within the Lagoon persists at levels less than 0.5% of the initial concentration one month after injection.

The location of the dye injection had an effect on how and to what degree the dye was transported. If the dye injection occurred downstream of the Lagoon along the main stem of the Willamette River, the majority of the dye is transported rapidly downstream with minimal transverse mixing. During extreme flood tidal conditions, minor concentrations could migrate upstream and enter the Lagoon, persisting at very low levels (0.005% of initial concentration one month post-injection). Similarly, there is a potential for the dye to migrate into the Lagoon from upstream sources along the main stem of the Willamette River. One month after injection, there are higher residual dye concentrations in the Lagoon and the entrance of the Lagoon than in the main stem of the River or at the release location. After reaching the entrance of the Lagoon, it took approximately four days before the dye was transported to the head of the Lagoon. The dye concentrations at the head of the Lagoon are orders of magnitude lower than in the main stem of the River, but persist for a much longer period of time.

If the dye is injected directly into the Lagoon there is a tendency for the dye to be forced to the head of the Lagoon before slowly flushing out of the Lagoon after several additional days. The dye does not completely flush out of the Lagoon but rather equilibrates to a near constant value across the Lagoon, at less than 0.5% of the initial concentration. When the dye is injected on the Swan Island side of the Lagoon, the movement of the dye into the main stem of the Willamette River occurs more quickly and it takes longer for the dye to spread to the head of the Lagoon than if the dye is injected on the Mocks Bottom side. The model simulations show there is a small clockwise current within the Lagoon during ebb tides, so as the dye is transported to the head of the Lagoon if it's injected from the Mocks Bottom side and to the entrance of the Lagoon from the Swan Island side. This transport pattern persists to varying degrees when the other injection locations are simulated. This flow and current pattern is influenced by the orientation of the entrance of the Lagoon; as water flows into the Lagoon during flood tides it is forced towards the Mocks Bottom side and the head of the Lagoon. Even though the flushing of the Lagoon begins more quickly when dye is injected on the Swan Island side, the location of the injection point does not significantly alter Lagoon concentrations one month post injection.

The results of this particle tracking analysis are extremely conservative in nature due to the neutral buoyancy of the dye, particularly for dye injections directly into the Lagoon due to the low average water velocity which would facilitate the settling of the non-cohesive particle sizes.

The dye tracer approach to studying the fate and transport of sediment particles (or any attached chemical of interest, COI) in the water column represents a conservative approach since it assumes a neutrally buoyant particle that allows the dye to travel the most under the tidally varying flow conditions. The dye tracer results indicate that dye released into the Lagoon tends to linger much longer in the Lagoon before its transport downstream. In some cases when the dye is released into the Willamette River, depending on the release location, the dye can be transported into the Lagoon. If the sediment particles had an associated settling velocity then they would be expected to settle out more quickly and closer to their release point, but the COIs dissolved in the water column may be expected to behave more like the dye and potentially be transported further from the release point.

Overall the dye tracer model simulation further confirmed that the Swan Island Lagoon is a depositional environment and more specifically:

- Dye releases into the Lagoon tend to stay in the Lagoon, with some mass lost to the Willamette River but a lingering plume in the Lagoon. These results indicate the velocities are very low and tend to keep discharges of even light particles around. If the dye (sediment) particles were heavier than they would sink faster and remain in the Lagoon.
- Dye releases in the main stem of the Willamette River tend to follow the east bank of the River closely and in some locations circulate around to spread into the Lagoon. This further reinforces the concept that the Lagoon receives sediments and water quality constituents from the main stem of the River, depending on where the discharges occur.

INTRODUCTION

The main objective of the Task 3 analysis was to better understand the transport potential of suspended particles (and potentially associated COIs) under various flow conditions. The AQ-EFDC Model (Model) supports a Lagrangian trajectory subroutine that allows the simulation of neutrally buoyant particles, such as a theoretical dye tracer. Using this subroutine, dye tracer model scenarios were developed to simulate the release of individual dye injections at ten specific locations in Swan Island Lagoon and along the east bank of the Willamette River as shown in Figure 1. The modeled or simulated dye does not degrade or react with other constituents and the particles are neutrally buoyant, neither sinking nor rising in the water column. Therefore, the dye particles do not have a settling velocity unlike suspended sediments. Conceptually this is similar to the dissolved phase of water quality constituents that may be present in the water column. The dye injections at Locations 1-9 were modeled as 3-hour slug inputs of a constant dye concentration of 100,000 units to simulate stormwater outfall flow during a storm event; these injections were repeated every three months in the simulations. The injection at Location 10 was modeled as a 48-hour dye slug injection of a constant dye concentration of 200,000 units to simulate discharge to the river from the Ballast Water Treatment Plant (BWTP) at the Swan Island Ship Yard. Table 1 shows the shortened six month/one year time periods simulated in the Model. The shortened simulation periods were implemented due to a greater resolution of the flow regimes (shortened periods used daily average flows to determine timeframes rather than annual average flows) and a reduction in computational effort. The dye inputs were treated as singular events; only one location experienced an injection per model simulation.

Table 1: Simulation Time Periods.

Scenario	Flow Regime	Five-Year Time Period	Six-Month/One-Year Time Period
1	Low Flow	October 1, 2000 - November 7, 2005	April 1, 1992 – September 30, 1992
2	Medium Flow	October 1, 1991 - September 30, 1996	October 1, 2004 – September 30, 2005
3	High Flow	September 28, 1995 - September 30, 2000	October 1, 1998 – September 30, 1999

The dye injection locations correspond to the City of Portland outfalls (Locations 3-8 (Vogt, 2002), a private outfall (Location 9), the BWTP outfall (Location 10), or were selected to better understand the effects of a shoreline release into the main stem of the Willamette River (Location 1), or near the Lagoon's entrance (Location 2). The upstream extent for model output on the main stem of the Willamette River was row #129 of the model grid for dye injection Locations 1-8, as notated by the white line in Figure 1. The locality of the dye injection Locations 9 and 10 necessitated the extension of the model output grid cells further upstream to row #118), as shown in Figure 1.

Figure 1: Dye injection point locations for tracer studies. The salmon colored area represents the extended model output cells for the tracer study. The white line represents the original upstream extent for model output.

MODEL SCENARIOS

In general, two model scenario types were investigated:

1) A comparison of dye concentrations using the same dye injection location between the flow regimes list in Table 1; and
2) A comparison of dye concentrations from the dye injection locations during the medium flow regime. The dye injections occurred independently of one another.

The two model scenario types illustrate transport of the dye during different flow regimes and from different locations in the Lagoon.

Comparison between Flow Regimes for Dye Releases at Location 8

Dye injections at Location 8 were simulated under the three flow regimes as listed in Table 1. The location was chosen due to its position in the middle of the Lagoon. The comparisons between the flow regimes were compared in January of each flow regime's respective simulation year, given in Table 1, because of the recurring nature of the slug injections in the simulations. The dye injections occurred every three months and after the first injection in January, there was zero dye concentration in the water column prior to the release, residual dye concentrations were present within the Model for the subsequent dye injections. These residual concentrations alter the spatial extent and magnitude of the concentration plumes of the newer dye slug injections, which made it difficult to accurately compare effects between the flow regimes.

Prior to conducting the comparisons between the flow regimes, an assessment was performed to verify the simulated hydrodynamics in the month of January 1992 were representative of the low flow regime, whose shortened simulation period began in April 1992 rather than the start of the water year in October 1991.. A comparison of the spatial and temporal dye concentration trends between the months of January and July, the month of the first dye injection in the shortened simulation period, in 1992 under the low flow regime demonstrated very little change, as shown in Figure 2 and Figure 3. Due to the similar trends and the generalized nature of the dye releases the use of the results from January 1992 were deemed acceptable as a surrogate for the low flow regime results.

The colors used in the time-series plot lines in the Figure 2 through Figure 5 correspond to the marker colors in the concentration gradient plot above the time series plot. The dye injection location is designated by the black color marker. Due to the large concentration of dye at the time of injection, a logarithmic scale was used for the vertical axis in the time-series plot. The magnitudes and overall trends of the dye concentrations at the various locations throughout the model domain are similar between the figures. One exception was the mid-channel concentrations lasted for a slightly longer timespan in July. This was due to the lower River flow rates, which made it more difficult to flush out dye during the ebb tide that had been transported upstream by the flood tide.

In Figure 3 through Figure 5, the time-series of dye concentrations at various locations throughout the Lagoon and the Willamette River are presented for the flow regimes over the month of January. Dye concentrations in the Lagoon (black, blue, and green line time-series) were similar for the low and high flow regimes whereas concentrations within the Willamette River (brown and gray line time-series) were more similar for the low and medium flow regimes.

Under the medium flow regime, the dye took longer to spread from the injection location, as is evident in the time-series plots for the black, blue and green markers. At the beginning of January 2005 (medium flow), the two daily high and low tides were fairly consistent and the water levels within the Lagoon did not fluctuate greatly; unlike January 1992 (low flow) when the tide was increasing or January 1999 (high flow) when the tide was decreasing. These tides accelerated the spread of the dye (to the head of the Lagoon if the tide was increasing or towards the entrance of the Lagoon if the tide was decreasing), resulting in the observed temporal patterns. Therefore, for each marker, there was a noticeable lag in either the decrease or increase in dye concentrations. For example, at the injection location, it took approximately one and a half days for the concentration to drop to 100 units under the low and high flow regimes, whereas it took approximately four days under the medium flow regime.

Under the various flow regimes, the dye was transported downstream along the northeast bank of the Willamette River. The concentrations along the bank (as shown by the purple and light blue line time-series plots) varied between 1 - 10 units throughout the month. At the end of the month, dye concentrations along the northeastern bank of the River became fairly constant at 1 unit across the flow regimes. This value is 0.001% of the injection concentration of 100,000 units. The dye concentrations within the Lagoon exhibited slight variations for the different flow regimes as shown in Table 2.

Table 2: Average concentrations in the Lagoon and along the northeastern bank of the River (downstream of the entrance of the Lagoon) approximately one month and three months after the dye injection at Location 8.

	End of January		End of March	
Flow Regime	Lagoon (units)	NE Bank (units)	Lagoon (units)	NE Bank (units)
Low	50	1	7	0.1
Medium	240	1	120	0.4
High	100	1	20	0.1

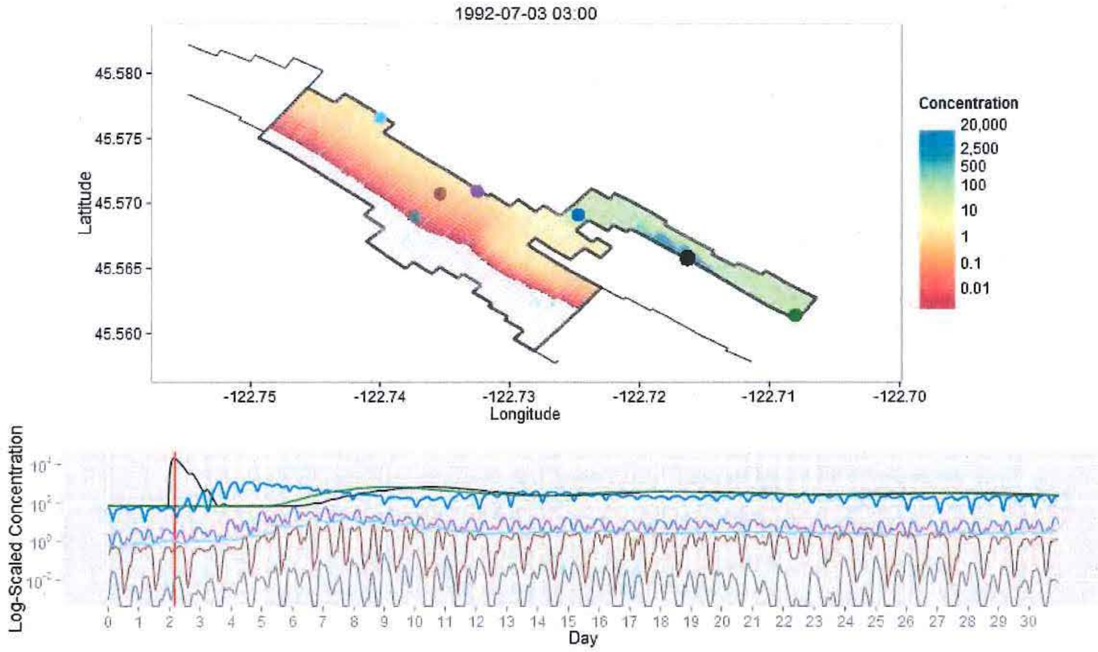

Figure 2: Dye concentrations at end of three-hour dye slug injection in July 1992 (low flow regime).

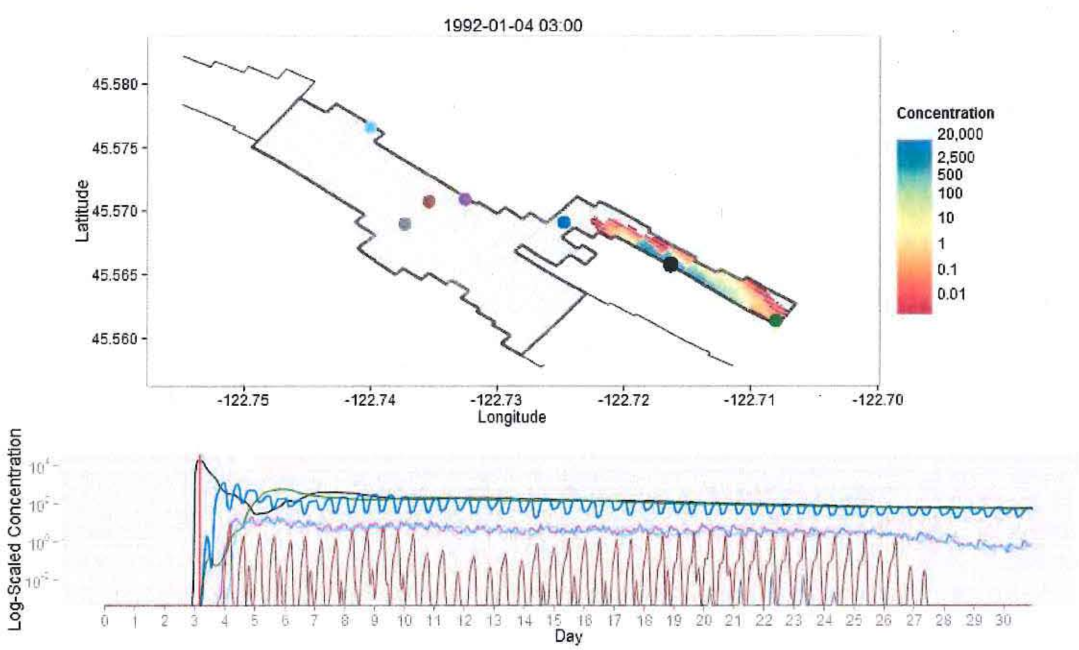

Figure 3: Dye concentrations at end of three-hour dye slug injection in January 1992 (surrogate for low flow regime).

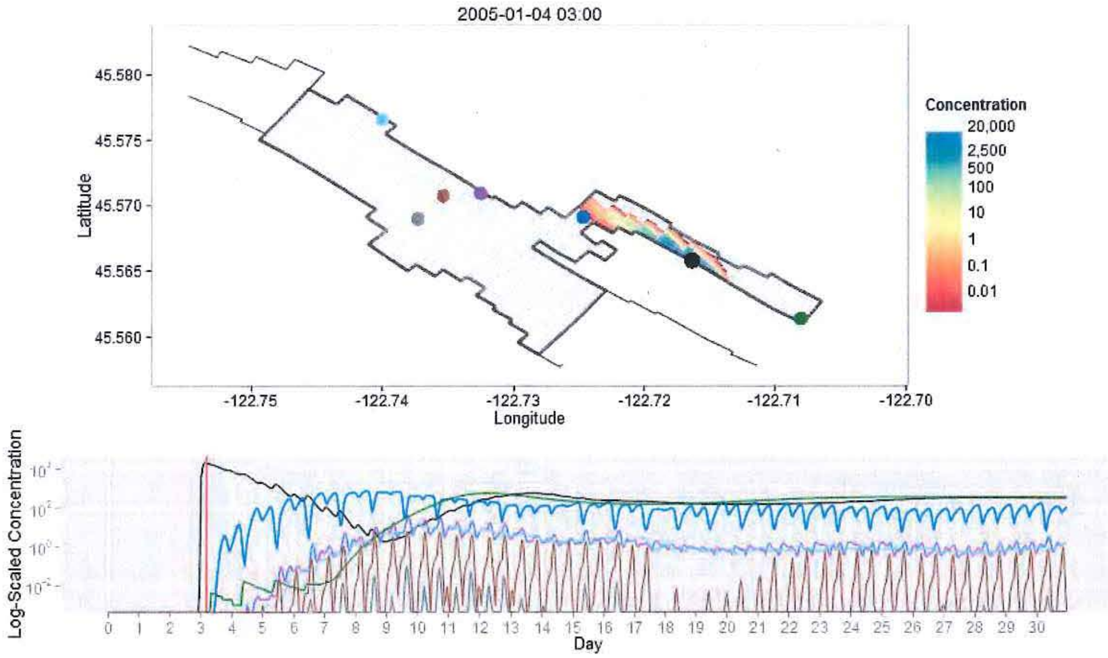

Figure 4: Dye concentrations at end of three-hour dye slug injection in January 2005 (medium flow regime).

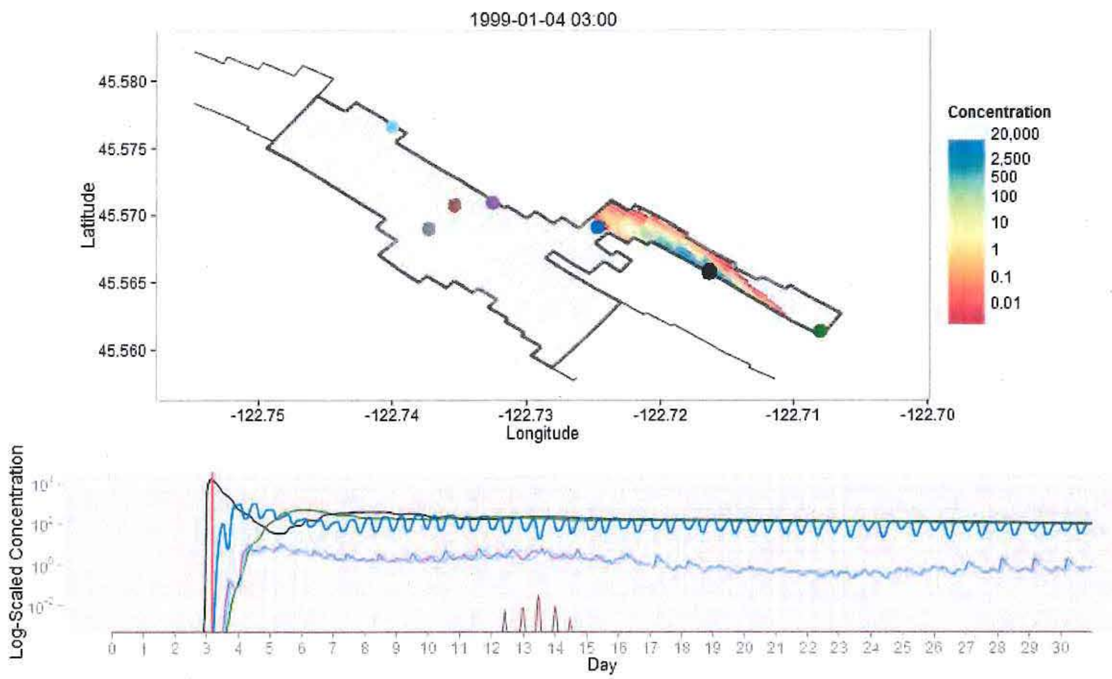

Figure 5: Dye concentrations at end of three-hour dye slug injection in January 1999 (high flow regime).

The Willamette River flow limited the degree of local transverse mixing; the line time-series for the brown and gray mid-channel marker locations in Figure 3 through Figure 5 illustrate the dye plume staying close to the River bank. Across the three flow regimes, the concentration at the brown marker location never exceeded 10 units as shown in Table 3. The average concentration during the low and medium flow regimes was approximately 0.2 units; the concentration dropped to 0.0001 units during the high flow regime. The dye concentrations at the gray marker location were negligible under the various flow regimes.

Table 3: Mid-channel concentrations per flow regime.

	Brown Marker		Gray Marker	
Flow Regime	Average Concentration	Maximum Concentration	Average Concentration	Maximum Concentration
Low	0.227	8.495	0.0001	0.019
Medium	0.187	6.075	0.001	0.098
High	0.0001	0.027	0	0

In order to better interpret the variations in the dye concentrations per flow regime, the model output was divided into four color coded regions, as shown in Figure 6. The average dye concentrations within each region were calculated at the end of the 3-hour dye injection and at one day, one week, one month, two months, and three months after the dye injection (Figure 7 through Figure 10). In general, the dye concentration trends are similar for the three flow regimes. The previously mentioned lag in the diffusion of the dye for the medium flow regime is apparent in Figures 8 and 9, but the main difference between the flow regimes is the retention of dye within the Lagoon during the medium flow regime as shown in Figure 7. Under this flow regime, the dye concentration in the Lagoon after one, two, and three months were approximately 290%, 500%, and 660%, respectively, higher than the concentrations for the high flow regime. The slower diffusion of dye and a strong flood tide explain the small spike in the upstream dye concentration after one week under the medium flow regime. The slower diffusion rate caused a greater concentration of the dye in the vicinity of the Lagoon and the strong flood tide moved the dye upstream.

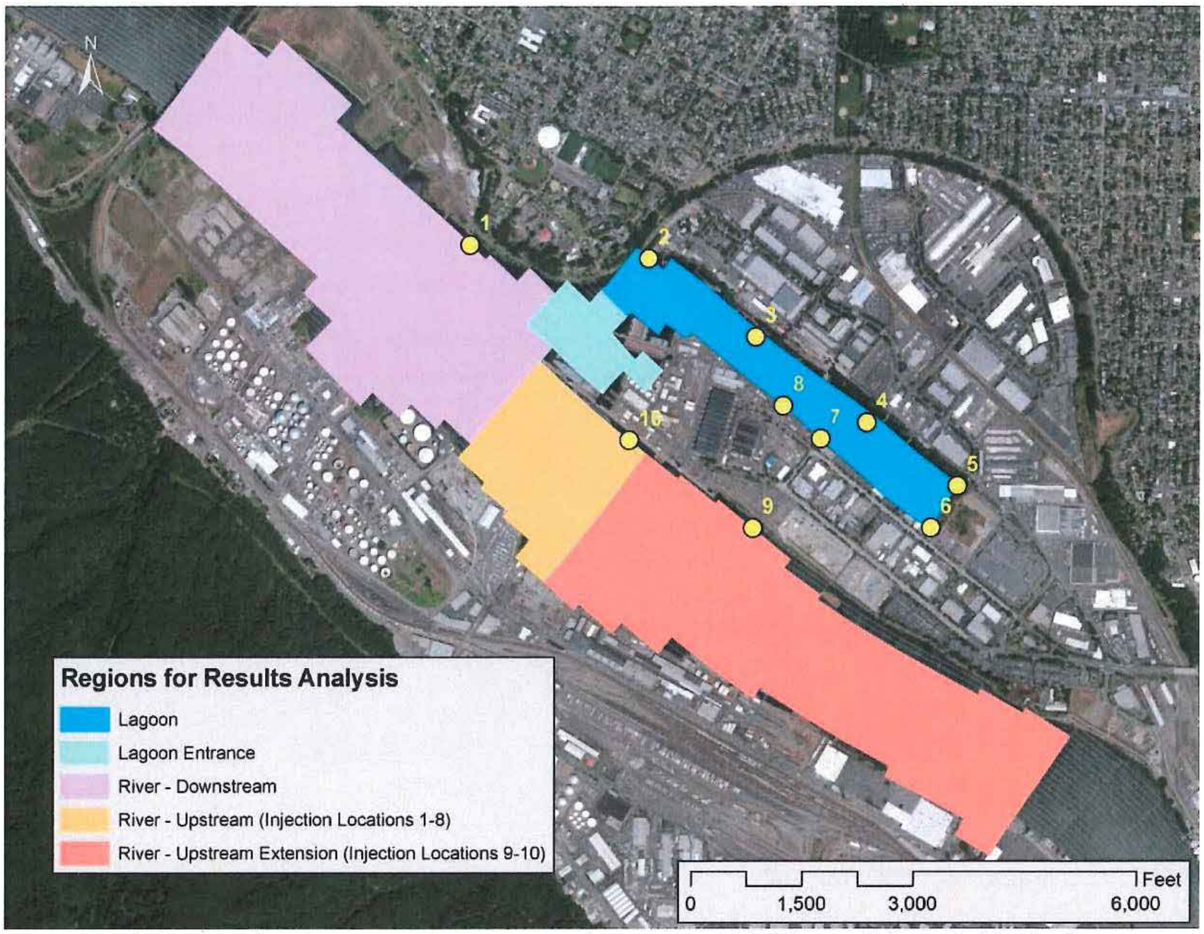

Figure 6: Regions for the average dye concentrations presented in Figures 7 through 10. The Lagoon, Lagoon entrance, and downstream regions were the same for the simulations. In computing the upstream average concentration (Figure 10), the orange region was used for simulations where dye was released at injection locations 1 through 8. For releases simulated at injection locations 9 and 10, the upstream region was extended to include both the orange and salmon regions.

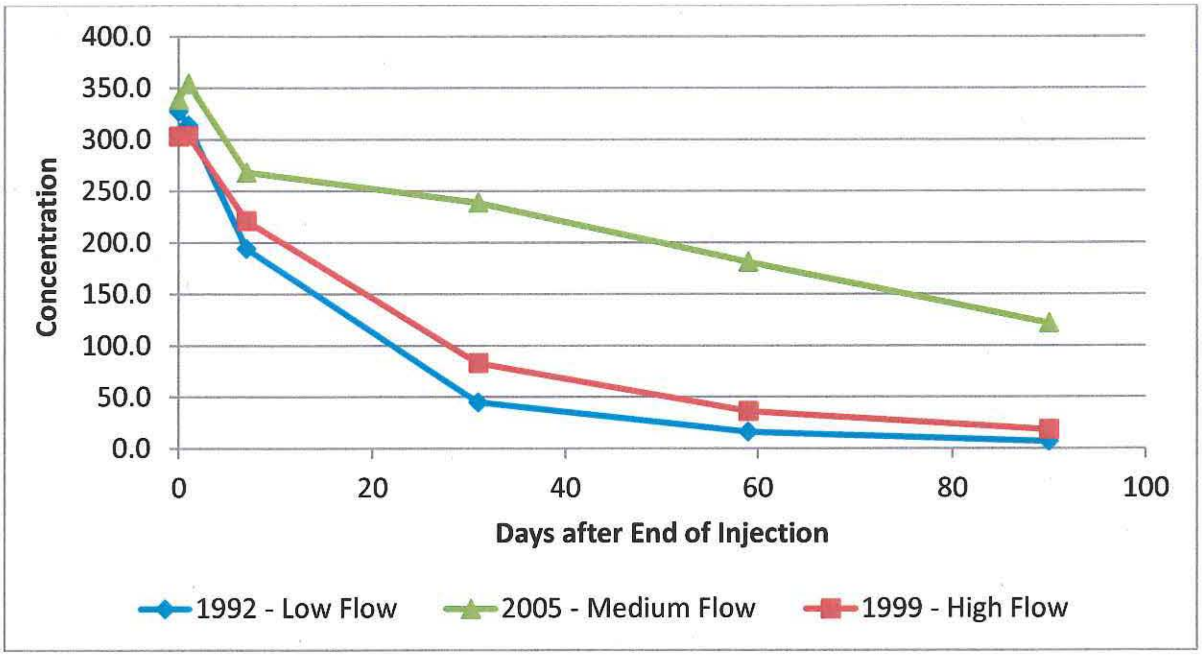

Figure 7: Average dye concentrations within the Lagoon per flow regime.

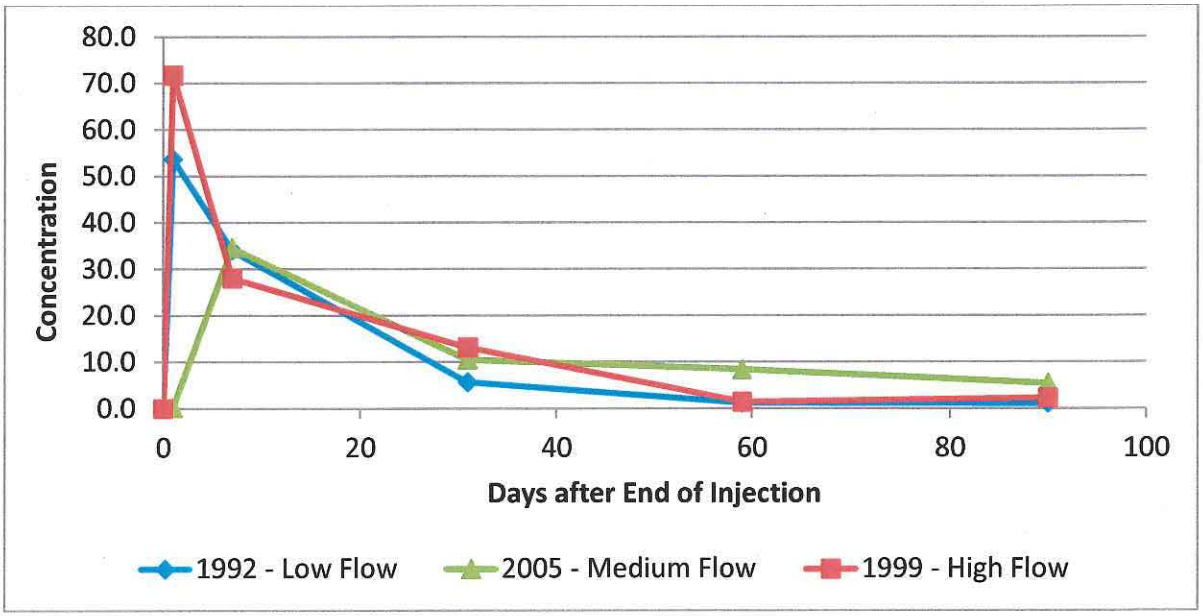

Figure 8: Average dye concentrations at the Lagoon entrance per flow regime.

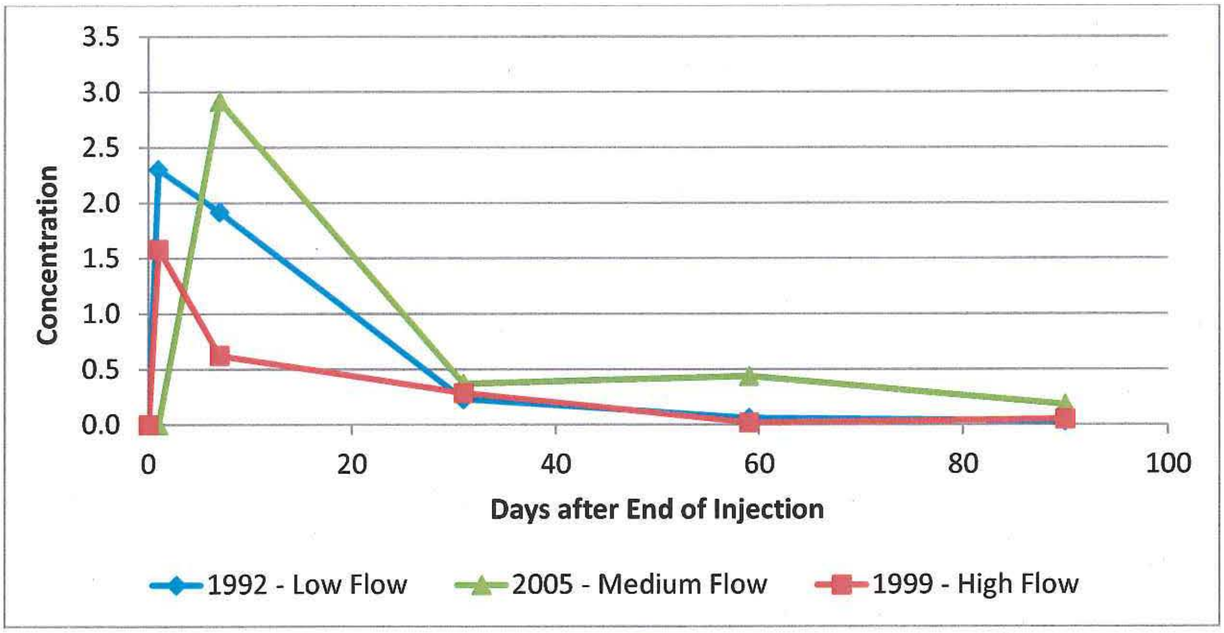

Figure 9: Average dye concentrations downstream of the Lagoon per flow regime.

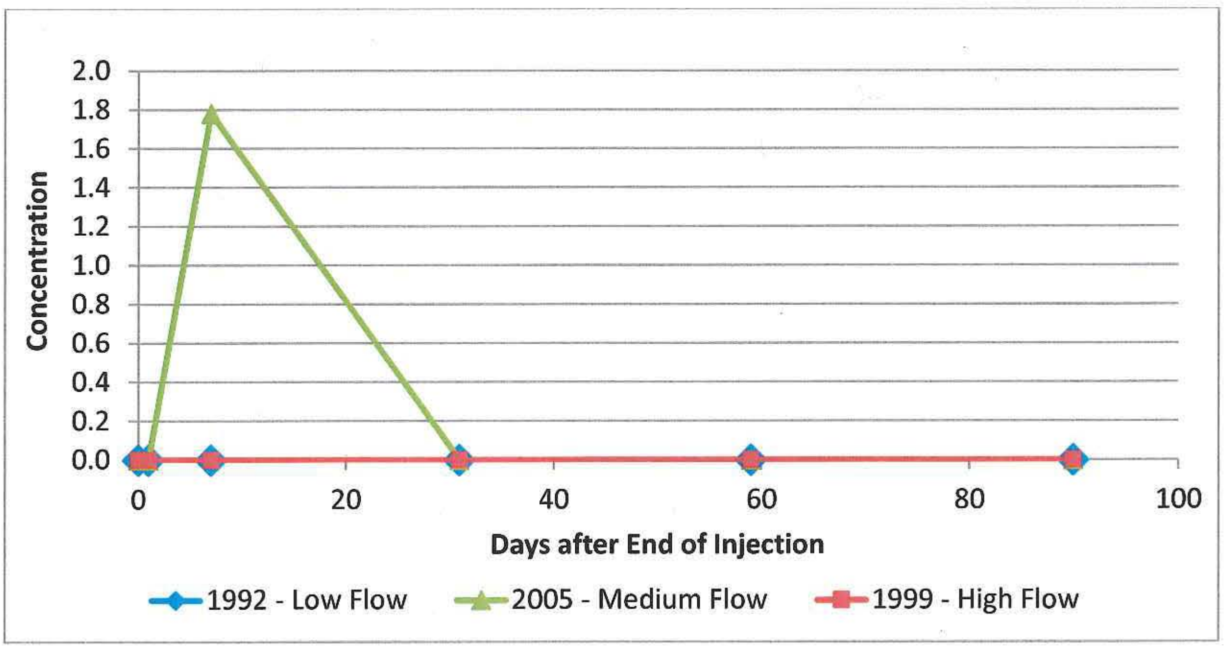

Figure 10: Average dye concentrations upstream of the Lagoon per flow regime.

The results of the first model scenario indicate the type of flow regime significantly altered the average dye concentrations in the Lagoon. Within the Lagoon, the medium flow regime consistently simulated average concentrations which were 100 - 150 units higher than the low or high flow regimes after one month due to the lower tidal influence during the medium flow regime. The largest average Lagoon dye concentration was approximately 350 units one day after the dye injection in the medium flow regime. Overall, the temporal patterns for the dye concentrations within the Lagoon were more similar between the low and high flow regimes, whereas those within the main stem of the Willamette River were more similar between the low and medium flow regimes. The similarities were due to the tidal cycle and magnitude of the Willamette River's flow, respectively. As previously mentioned, the timing of the semidiurnal tidal cycle caused a delay in the transport of the dye within the Lagoon during the medium flow regime, and illustrated the effect the tide has on the hydrodynamics within the Lagoon. The flow within the main stem River during the high flow regime was great enough to limit almost all transverse mixing, rapidly transporting the dye along the northeast bank of the River instead.

Comparison of Injection Locations under the Medium Flow Regime

The second type model scenario investigated was the comparison of the dye concentrations based on dye injection location under the medium flow regime. The medium flow regime was chosen as the conservative option, based on the higher average dye concentrations, in general, during the flow regime. Five of the ten injection locations are discussed below; the results for the remaining locations were too similar to those presented to warrant their own discussion and can be found in Appendix A. Location 10, corresponding to the BWTP discharge location, is one of those discussed. This injection location has a dye concentration two times what was used at the other injection locations and the dye injection lasted for 48-hours rather than three hours. The main result was an increase in the dye concentration found within the Lagoon at the end of January from approximately 2 units to 20 units in comparison to other main stem River injection locations.

For each injection location, several figures have been provided (Figure 11 through 71). First, an image delineating the locations of individual model cells where dye concentration time-series output is presented, followed by the color-coded time-series plots. In these plots, the time-series plot for the injection location is shown in black with a small gap occurring at day three. The gap is due to limiting the plotted concentration values so that variations in the dye concentration are distinguishable at the lower concentration levels. The maximum simulated dye concentration for each cell is also presented in the plots.

Next, a composite figure consisting of a dye concentration gradient plot and its related color-coded time-series plot is presented. The gradient plot is a visualization of dye concentrations throughout the Lagoon and within the localized region of the Willamette River at the end of the 3-hour dye input. The time-series plot is a composite plot which illustrates dye concentrations at distinct cells for the entire month of January, not just an individual cell. Due to the large variation in dye concentrations simulated throughout the study area, the concentrations in the time-series plot are on a log-scale. The red vertical line in the time-series plots indicates the simulation time at which the spatial gradient plot was produced.

After the composite figure, three spatial gradient plots are presented which illustrate the spatial variation of dye concentrations within the study area at three specific points in time: one day, one week, and one month after the end of the dye injection. These plots are provided to better display the transport of dye over time.

Dye Injection Location #1

The individual model cell locations and associated time-series for the dye injection at Location #1 (IL1) that corresponds with a hypothetical outfall on the northeast bank of the main stem of the River downstream of the Lagoon are shown in Figure 11 and Figure 12. This location was chosen to investigate if dye could be transported from a downstream source into the Lagoon in a significant manner. As Figure 12 illustrates, dye was quickly transported downstream when released directly into the main stem of the Willamette River, resulting in the large spike in the green line time-series plot. Table 4 lists the sum of the dye concentrations by each spatial region shown in Figure 6. After one day, there was a 94% reduction dye concentration within the downstream region with an overall reduction of approximately 85%. The discrepancy in the two percentages is due to dye aggregating at the entrance to the Lagoon. Due to the flow of the Willamette River, transverse spreading of the dye was minimal, shown by the pink time-series plot in Figure 12, and the majority of the dye was conveyed along the northeastern bank of the Willamette River as shown in Figure 13 through Figure 16. During flood tide, a small amount of dye was transported upstream where it entered the Lagoon and persisted at very low concentrations, as shown by the blue time-series plot in Figure 12 and both the blue line and the brown line time-series plots in Figure 13.

The temporal patterns found in the composite time-series plot in Figure 13 were due to tidal fluctuations in Willamette River flow. Figure 15 illustrates the ability of these fluctuations to force dye upstream. In general, the average dye concentrations persist at very low levels a month after release: approximately 5 units within the Lagoon, 1 unit at the Lagoon's entrance, and 0.01 units within the main stem of the Willamette River, as shown in Figure 16. These concentrations equate to 0.005%, 0.001%, and 0.00001% of the release concentration, respectively. Therefore, the dye can be transported upstream but not in any significant quantities.

The temporal patterns and magnitudes of dye concentrations for injection at Location #9 were similar to this location and the figures for that location (Figure 66 - Figure 71) can be found in Appendix A.

Conclusion: Releases from this location would primarily migrate downstream along the bank and very minor concentrations could migrate upstream into the Lagoon during tidal events.

Figure 11: IL1 - Model cell locations of individual dye concentration time-series and associated time series plot colors.

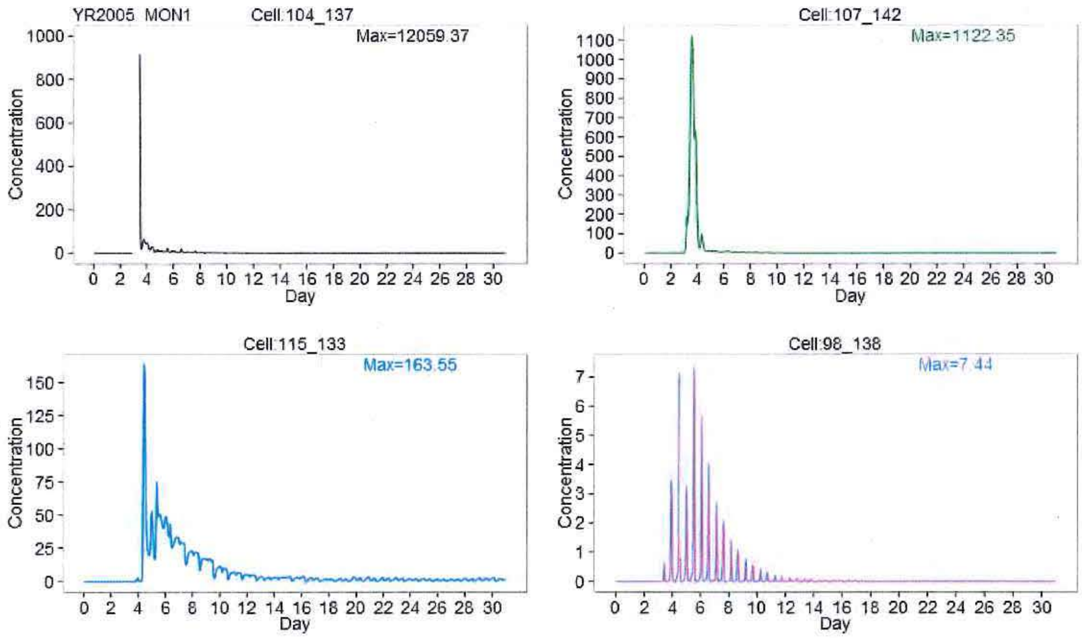

Figure 12: IL1 - Individual model cell dye concentration time-series.

Table 4: IL1 - Sum of dye concentrations within spatial regions at end of the 3-hour dye injection and one day after injection. A value of 'n/a' signifies no reduction in concentrations after the one day.

	Lagoon	Lagoon Entrance	River - Downstream	River - Upstream	Totals
End of Injection	0.00	0.00	37,368.57	0.00	37,368.57
1 Day After End	0.21	3,522.55	2,151.49	0.00	5,674.26
% Reduction	n/a	n/a	94.2%	n/a	84.8%

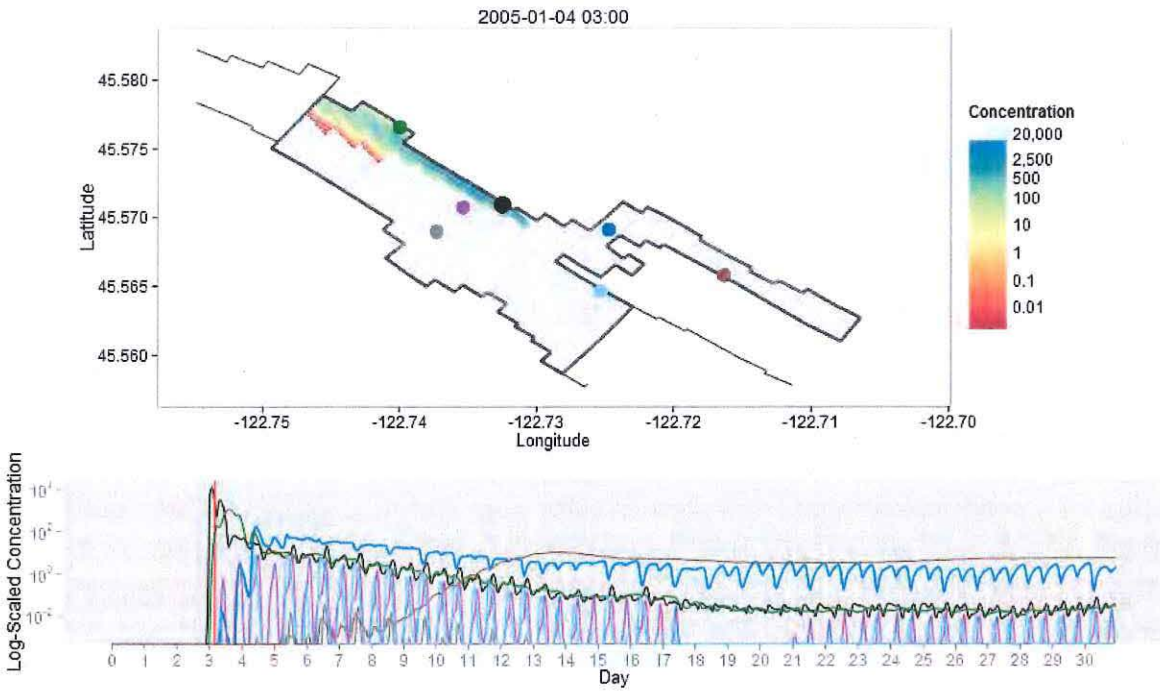

Figure 13: IL 1 - End of 3hr dye slug injection.

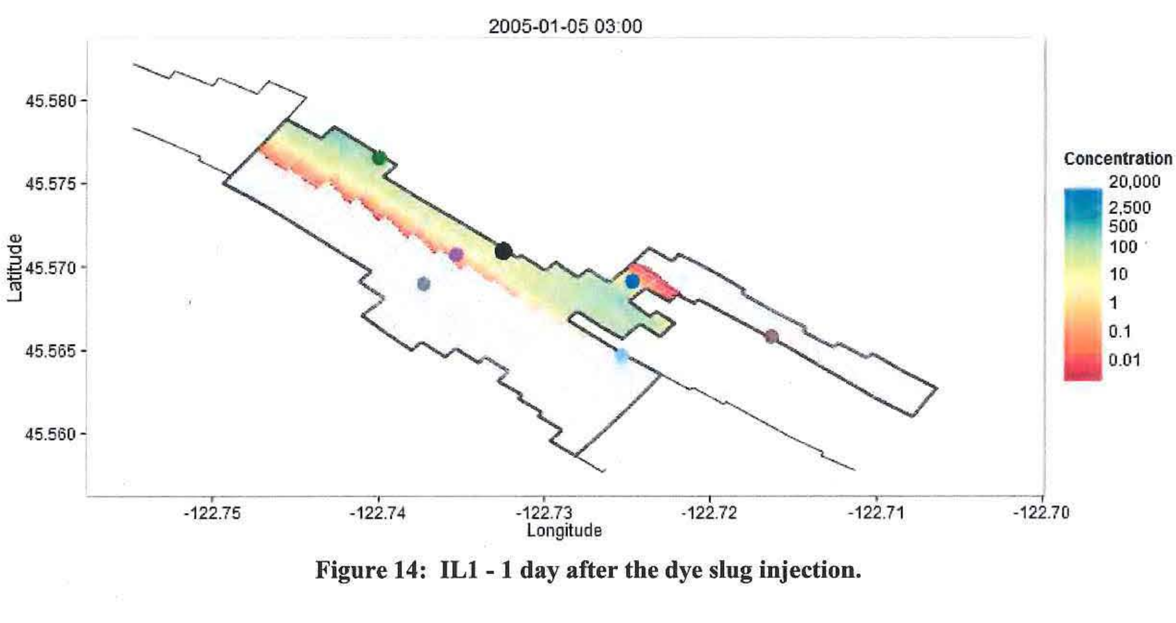

Figure 14: IL1 - 1 day after the dye slug injection.

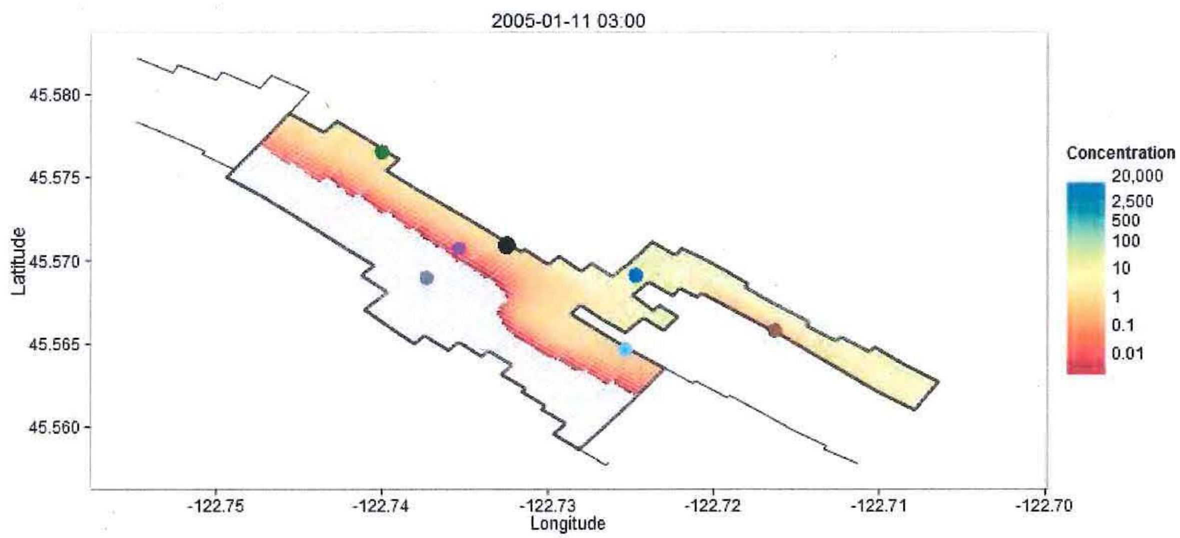

Figure 15: IL1 - 1 week after the dye slug injection.

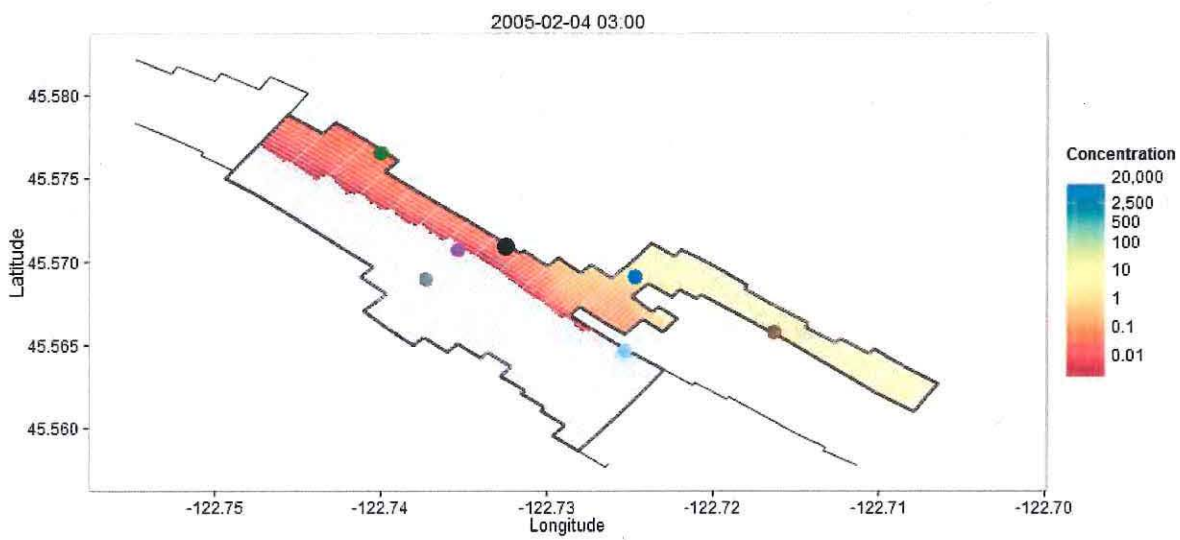

Figure 16: IL1 - 1 month after the dye slug injection.

Dye Injection Location #2

The individual model cell locations and the time-series plots for the dye injection at Location #2 (IL2), corresponds to a private outfall approximately 700 ft. northeast (NE) of the Lagoon's entrance, are shown in Figure 17 and Figure 18. IL2 was investigated to determine if the dye introduced at the Lagoon entrance would exhibit a greater transport potential than those introduced within the Lagoon proper. The majority of the dye was initially retained within the Lagoon before slowly flushing into the main-stem of the Willamette River and transported downstream, as shown in Figure 19 through Figure 22 and Table 5. According to Table 5, the overall percent reduction in dye concentrations after one day was 24.5%; this was a much lower reduction than was experienced under IL1. This was not unexpected since, as Figure 20 illustrates, the dye was just beginning to leave the Lagoon after one day.

When the dye is directly injected into the Lagoon, including the entrance, a secondary spike in the time-series concentration for that location occurred, as shown by the black time-series in Figure 18. This occurred due to the aforementioned movement of the dye around the Lagoon. The dye does not completely flush out of the Lagoon but rather equilibrates to a near constant value, as shown by the concentrations at the end of the simulation period for the black and green line time-series in Figure 19 which represent the dye concentrations at the head and entrance of the Lagoon, respectively. Similar to IL1, the dye moved along the northeastern bank of the Willamette River when transported downstream. Tidal variations were large enough to force small amounts of the dye upstream for a limited time as shown in Figure 21.

In general, the average dye concentrations a month after release were as follows: approximately 290 units within the Lagoon, 15 units at the Lagoon's entrance, and 1 unit within the main stem of the Willamette River, as shown in Figure 22. These concentrations equate to 0.29%, 0.015%, and 0.001% of the dye release concentration, respectively. The patterns and magnitudes of concentrations for injection Locations #3 through #8 were similar to this location and the figures for those locations (through Figure 65) are presented in Appendix A.

Conclusion: The dye release locations at the entrance of the Lagoon show dispersion and persistence of higher concentrations within the lagoon. Dilute dye concentrations migrate downstream along the bank.

Figure 17: IL2 - Model cell locations of individual dye concentration time-series and associated plot colors.

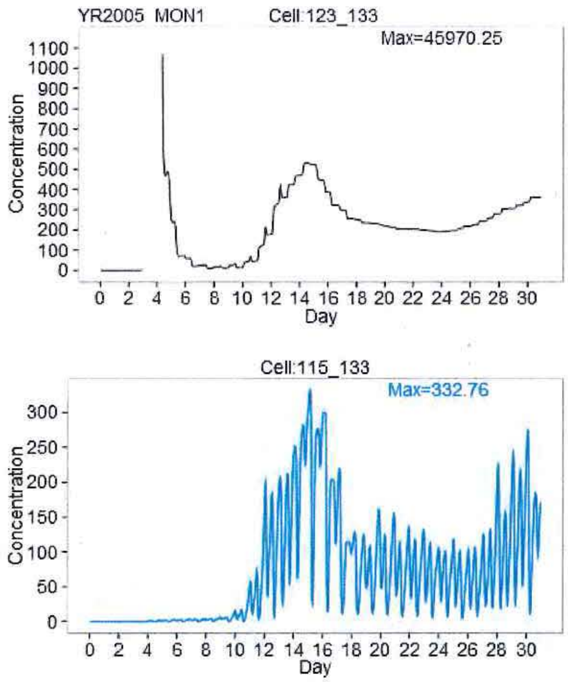

Figure 18: IL2 - Individual model cell dye concentration time-series.

Table 5: IL2 - Sum of the dye concentrations within explanatory regions at end of the 3-hour dye injection and one day after injection. A value of 'n/a' signifies no reduction in concentrations after the one day.

	Lagoon	Lagoon Entrance	River - Downstream	River - Upstream	Totals
End of Injection	47,383.20	0.00	0.00	0.00	47,383.20
1 Day After End	35,759.83	0.92	0.00	0.00	35,760.75
% Reduction	24.5%	n/a	n/a	n/a	24.5%

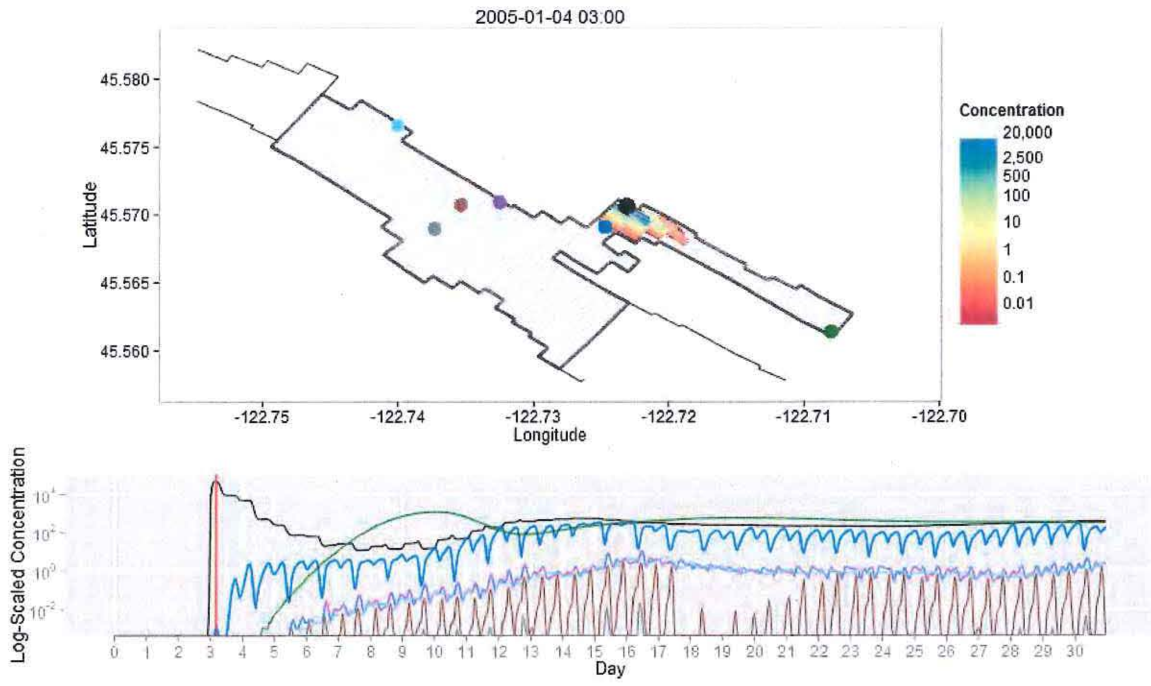

Figure 19: IL2 - End of 3hr dye slug injection.

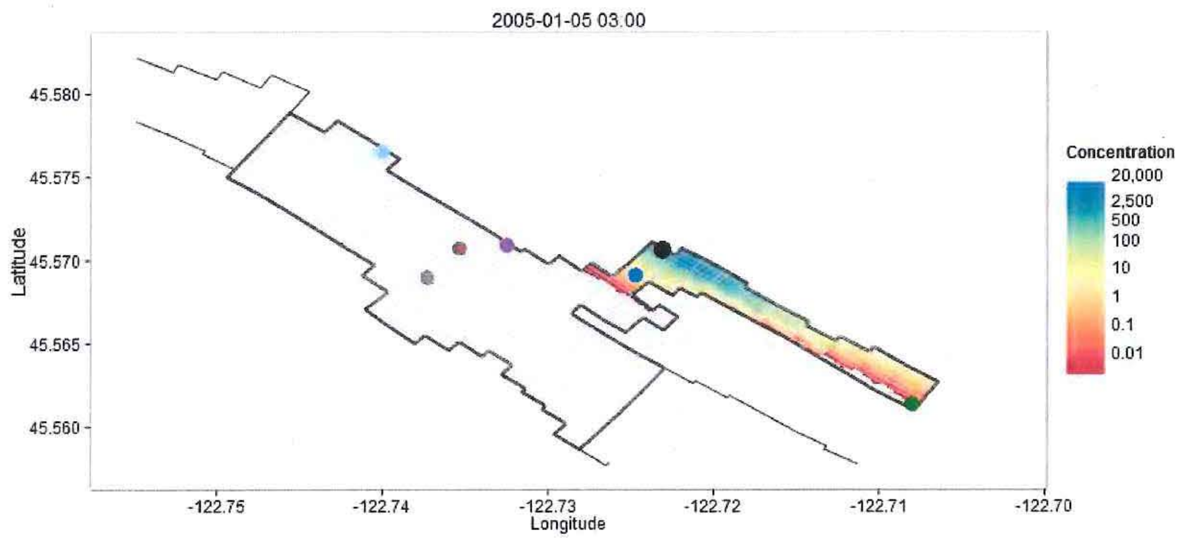

Figure 20: IL2 - 1 day after the dye slug injection.

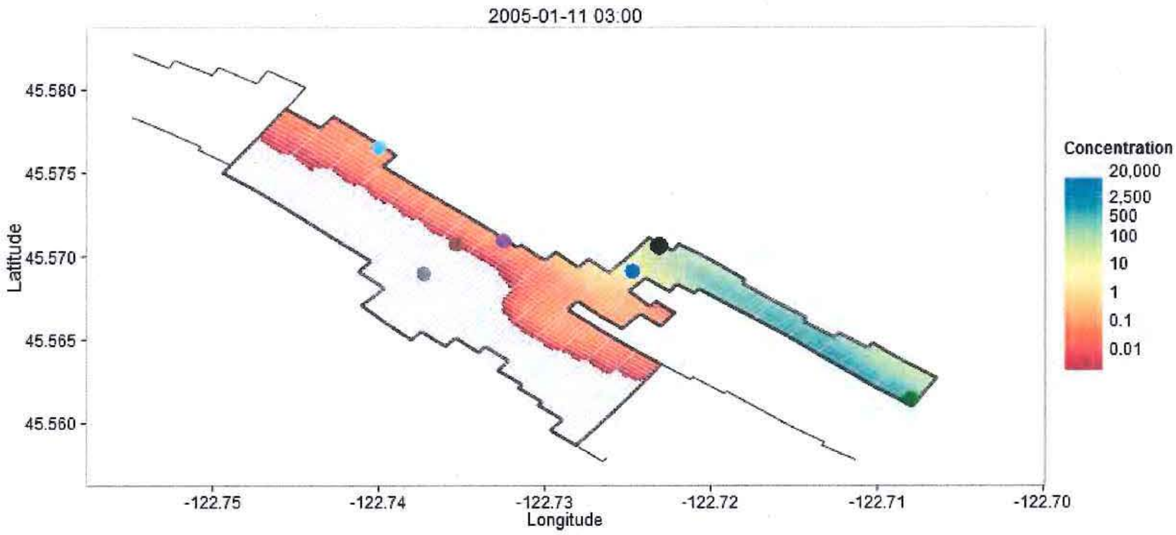

Figure 21: IL2 - 1 week after the dye slug injection.

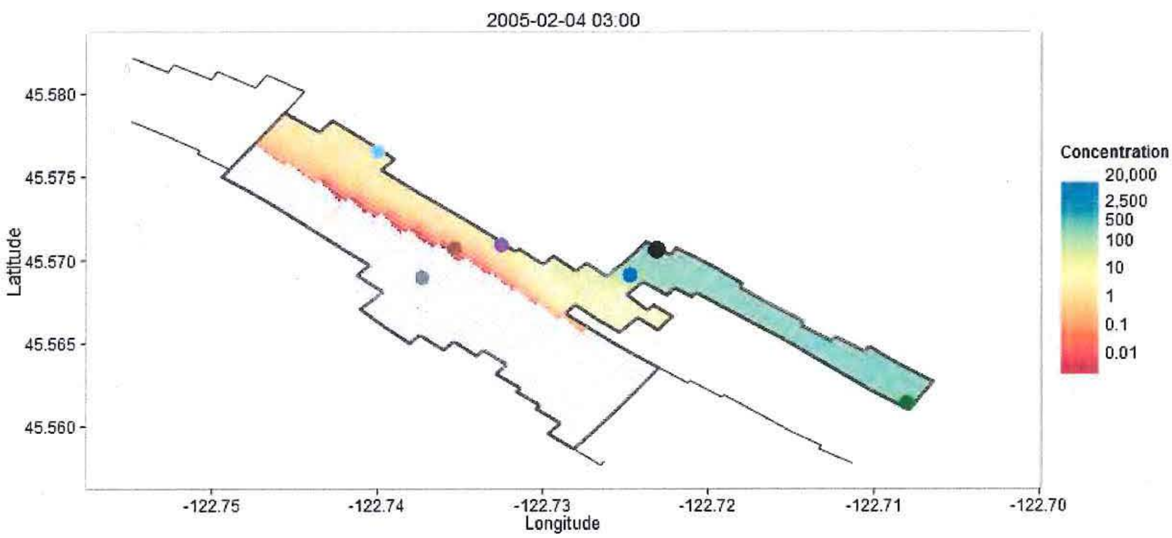

Figure 22: IL2 - 1 month after the dye slug injection.

Dye Injection Location #3

Dye Injection Location #3 (IL3) corresponds to the City of Portland's stormwater outfall (OFM-1) located approximately 2,300 ft. east-southeast (ESE) from the entrance of the Lagoon on the Mock's Bottoms side. The individual model cell locations and associated dye concentrations time-series for the IL3 injection location are shown in Figure 23 and Figure 24.

In Figure 24, the vertical scale on each plot is different to accurately show concentration changes over time at each location. Once again, the gap in the dye concentration time-series of the upper left plot is due to limiting the vertical concentration scale to 1,000 units in order to better visualize the concentration temporal patterns post injection. There is no actual gap in the model output. As Figure 24 illustrates, approximately three days or one week passed since the dye injection before a dye concentration was detected at the head or entrance of the Lagoon, respectively. The greatest flux of dye experienced in the main stem River was downstream of the Lagoon and occurred approximately 13 days after the injection.

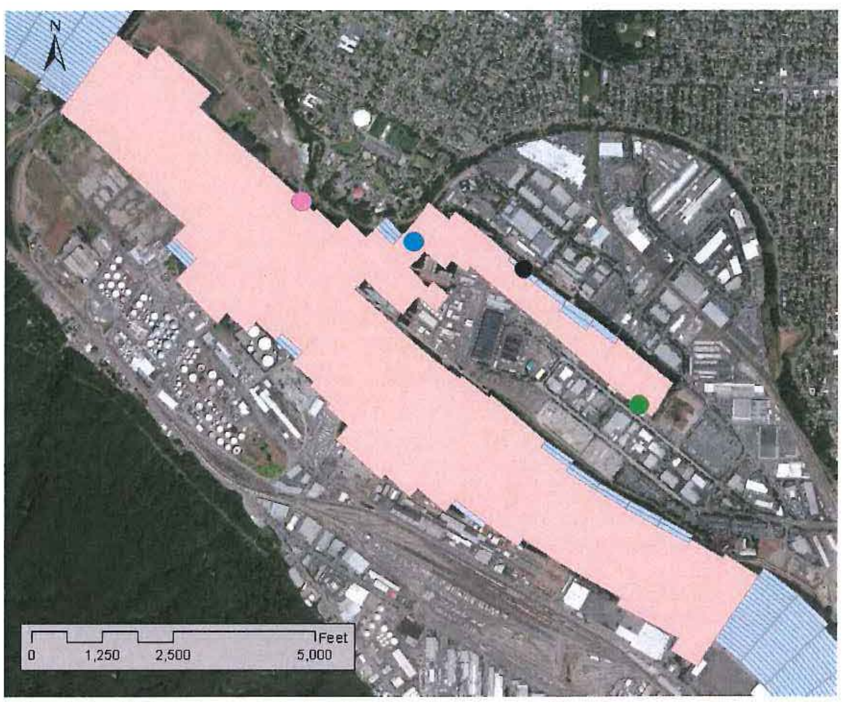

Figure 23: IL3 - Model cell locations of individual dye concentration time-series and associated plot colors.

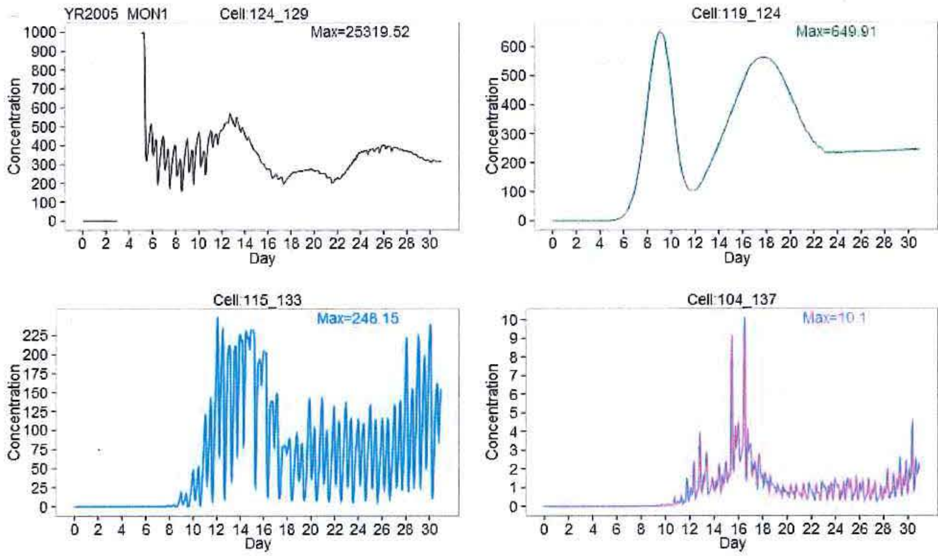

Figure 24: IL3 - Individual model cell dye concentration time-series.

Similar to IL2 location, the majority of the dye injected at IL3 was initially retained within the Lagoon before being slowly flushed into the main stem of the Willamette River and transported downstream, as shown in Figures 25 through 28. In addition, a secondary spike in the dye time-series concentration occurred, shown by the black and green line time-series plots in Figure 24. Approximately one week after the dye injection, the dye concentration reached a near constant value within the Lagoon, with slightly elevated concentrations in the middle of the Lagoon as compared to the entrance and head of the Lagoon, notated by the darker green coloring in Figure 27. Similar to IL1 and IL2, the dye plume moved along the northeastern bank of the Willamette River when transported downstream. Once again, tidal variations were large enough to force a small amount of dye upstream for a limited time as shown in Figure 27.

In general, the average dye concentrations a month after release were as follows: approximately 300 units within the Lagoon, 14 units at the Lagoon's entrance, and 1 unit within the main stem of the Willamette River, as shown in Figure 28. These concentrations equate to 0.30%, 0.014%, and 0.001% of the release concentration, respectively.

Conclusion: Dye release locations in the upper portion of the Lagoon show dispersion and the persistence of higher concentrations within the Lagoon similar to release locations at the entrance of the Lagoon. Dilute concentrations migrate downstream along the northeastern bank with very little transverse mixing in the main stem of the River.

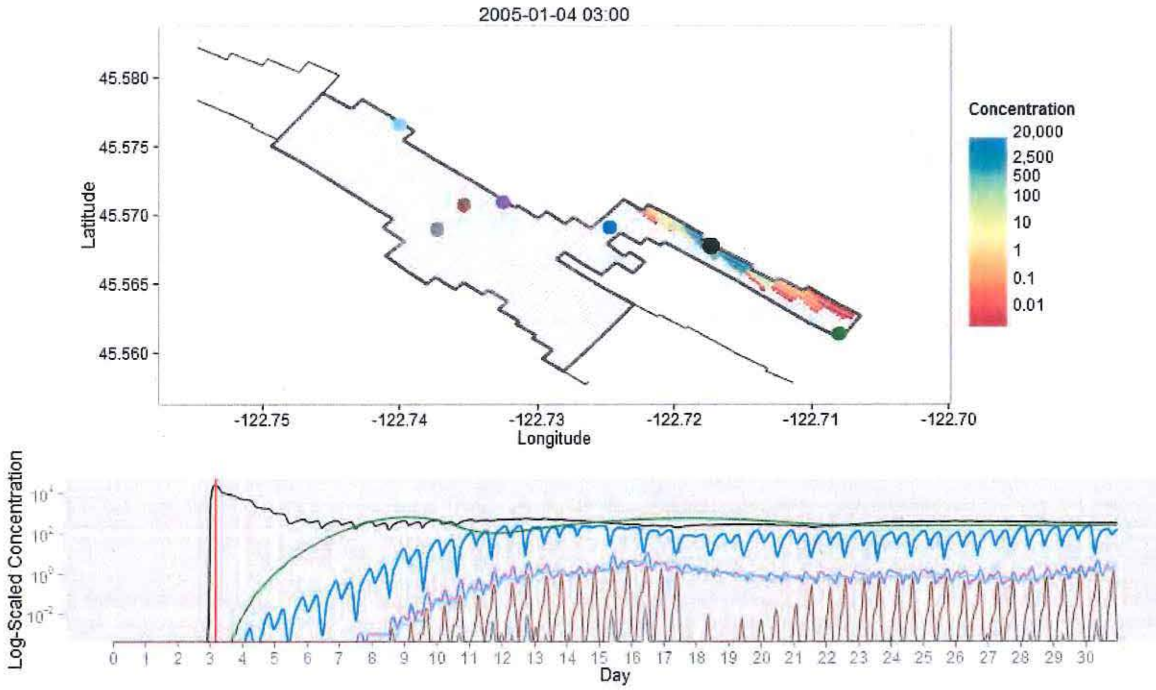

Figure 25: IL3 - End of 3 hour dye slug injection.

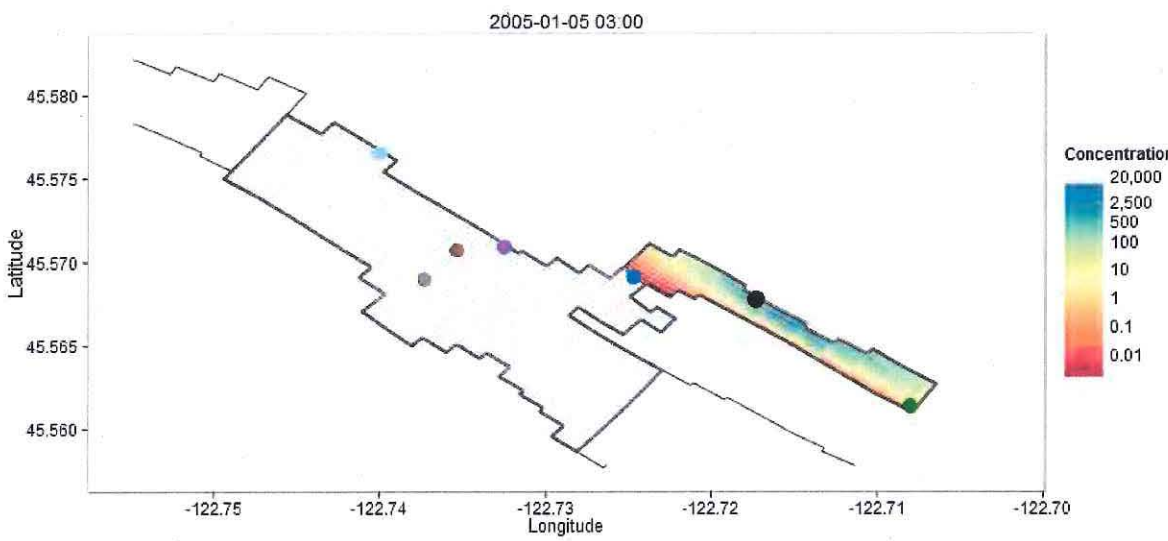

Figure 26: IL3 - 1 day after the dye slug injection.

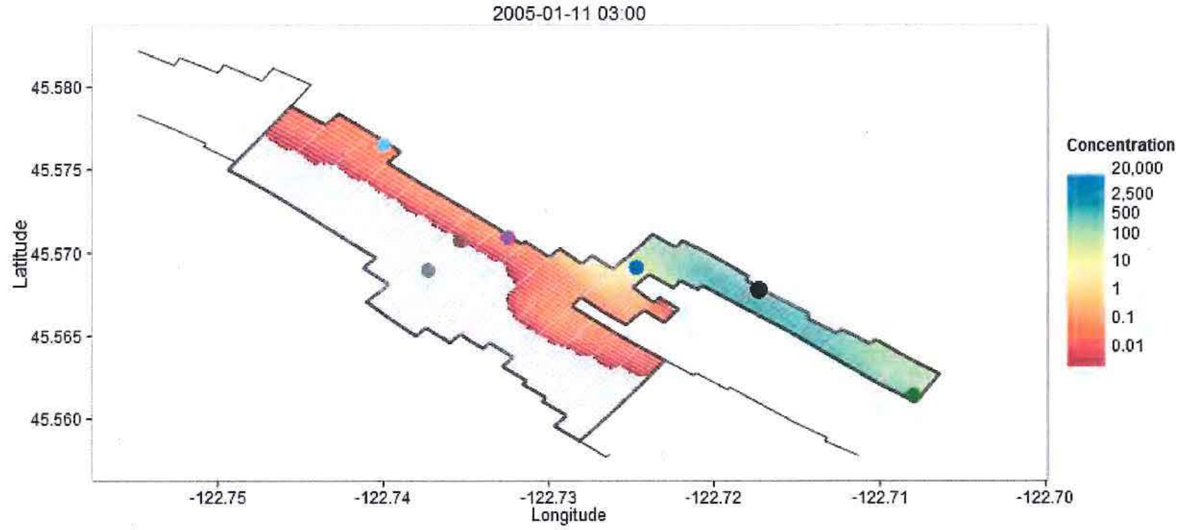

Figure 27: IL3 - 1 week after the dye slug injection.

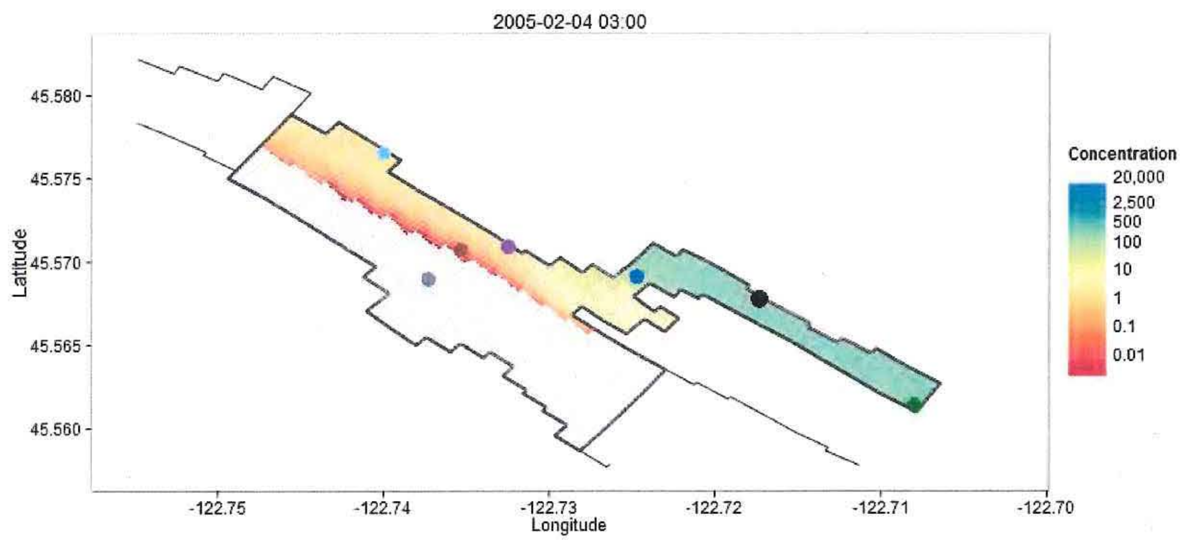

Figure 28: IL3 - 1 month after the dye slug injection.

Dye Injection Location #7

The dye Injection Location #7 (IL7) corresponds to the City of Portland's stormwater outfall located approximately 3,300 ft. southeast (SE) from the entrance of the Lagoon on the Swan Island side of the Lagoon. The individual model cell locations and associated dye concentration time-series for IL7 are shown in Figures 29 and 30.

Figure 29: IL7 - Model cell locations of individual dye concentration time-series and associated plot colors.

When the dye is injected on the Swan Island side of the Lagoon, the movement of dye into the main stem of the Willamette River occurs more quickly and it takes longer for the dye to spread to the head of the Lagoon. Comparing Figures 25 and 31 suggests there is a small clockwise current within the Lagoon during ebb tides, as the dye is transported to the head of the Lagoon from IL3 and to the entrance of the Lagoon from IL7. This clockwise current is exhibited in Figure 32, a plot of the simulated velocity vectors six hours after the end of dye injection. This pattern persists in varying degrees with the other dye injection locations, indicating the dye injected from the Mocks Bottom side of the Lagoon preferentially travels towards the head of the Lagoon while the dye injected from the Swan Island side travels towards the entrance of the Lagoon during ebb tides. The flow pattern is influenced by the orientation of the entrance of the

Lagoon; as water flows into the Lagoon during flood tides it is forced towards the Mocks Bottom side and the head of the Lagoon.

The accelerated transport of the dye out of the Lagoon is shown by comparing the timing of the dye concentration spikes in the blue and pink line time-series in Figures 24 and 30. In Figure 24, the maximum dye concentrations occur on day 15 and 16, approximately, for model cells at the entrance of the Lagoon and downstream of the Lagoon, respectively. In Figure 30, these concentrations occur on day 9 and 11. Even though the flushing of the Lagoon begins more quickly when the dye is injected on the Swan Island side, the equilibrated Lagoon concentrations one month after the dye injection do not significantly vary between the IL3 and IL7 dye injection simulations. However, the secondary spike in dye concentrations notated in the green line time-series at IL2 and IL3 is not seen at IL7.

Conclusion: The dye release locations on the Swan Island side of the Lagoon experience accelerated transport out of the Lagoon and a longer travel time to the head of the Lagoon compared to dye released on the Mocks Bottom side of the Lagoon. The dye transport suggests there is a minor clockwise current within the Lagoon, particularly during ebb tides.

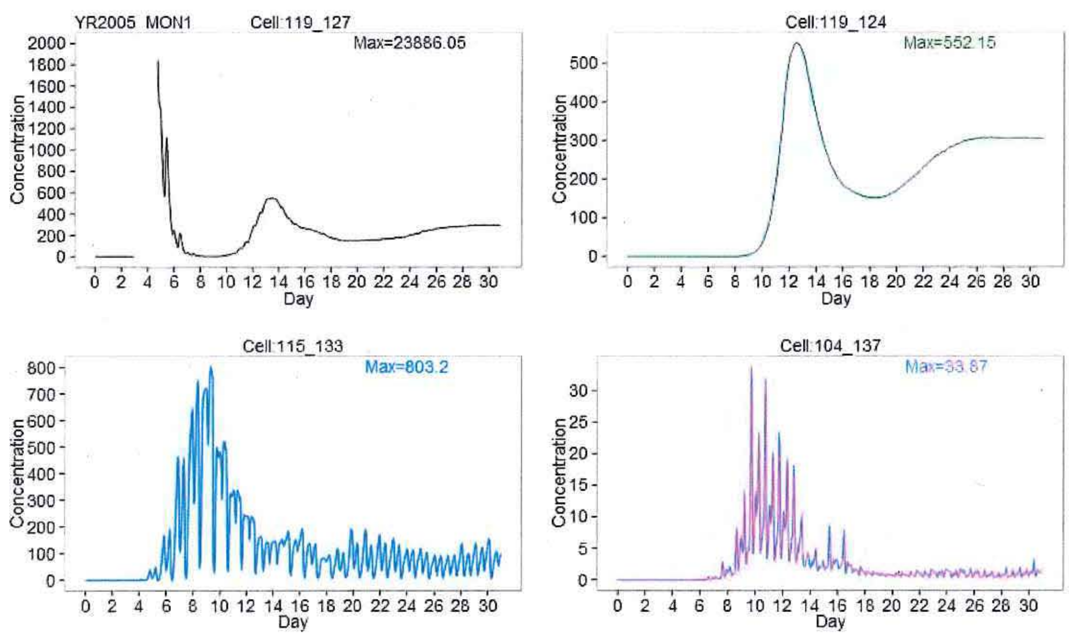

Figure 30: IL7 - Individual model cell dye concentration time-series.

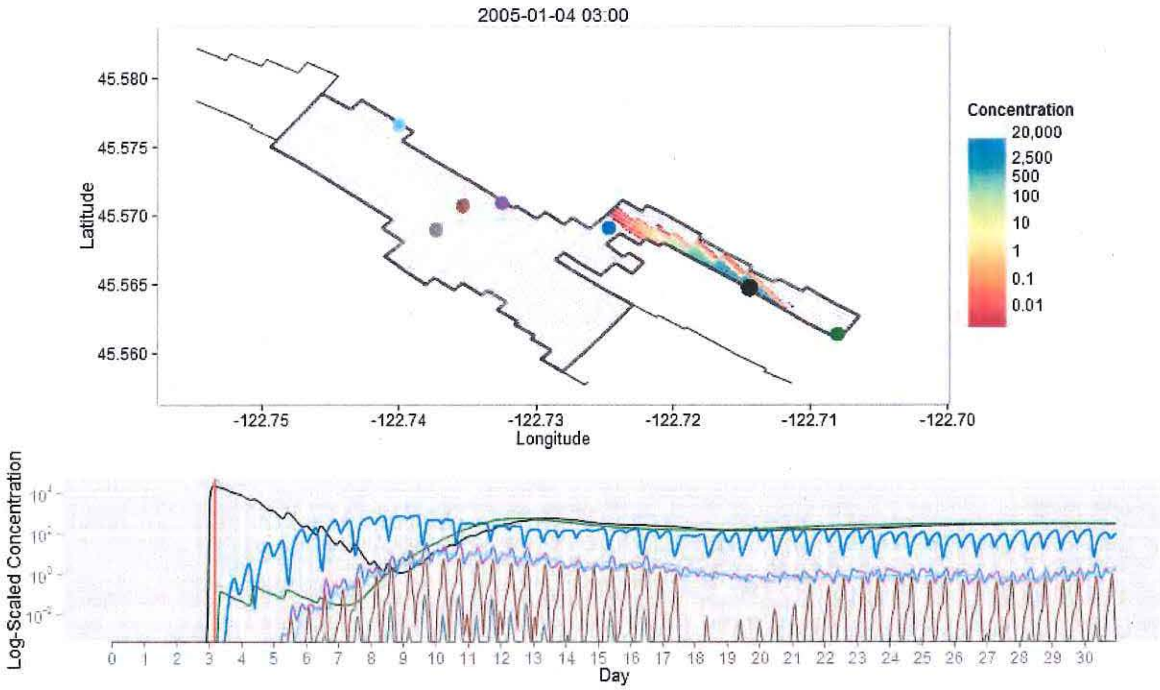

Figure 31: IL7 - End of 3hr dye slug injection.

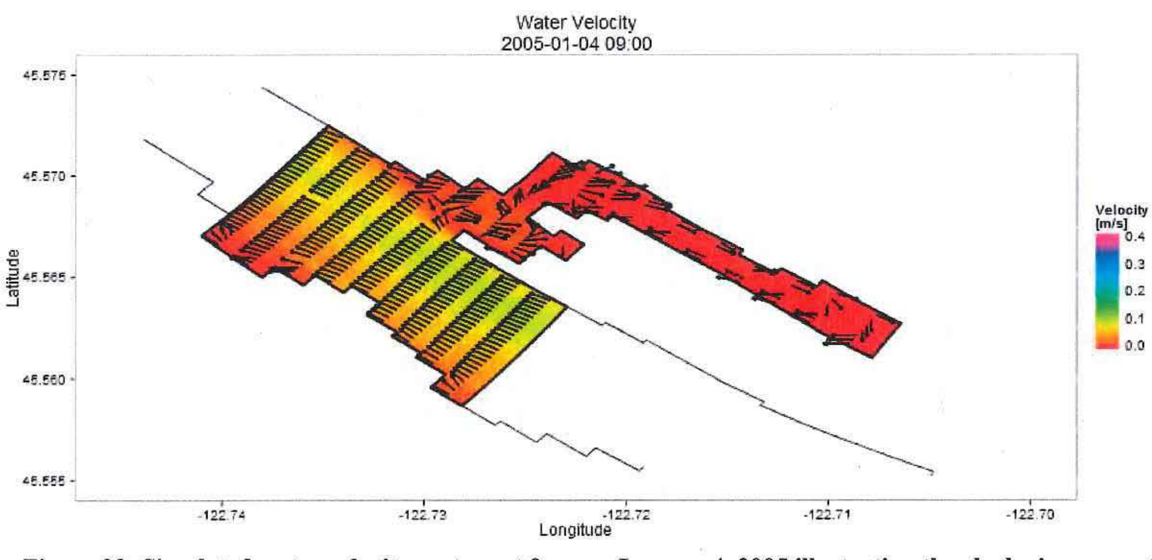

Figure 32: Simulated water velocity vectors at 9am on January 4, 2005 illustrating the clockwise current within the Lagoon.

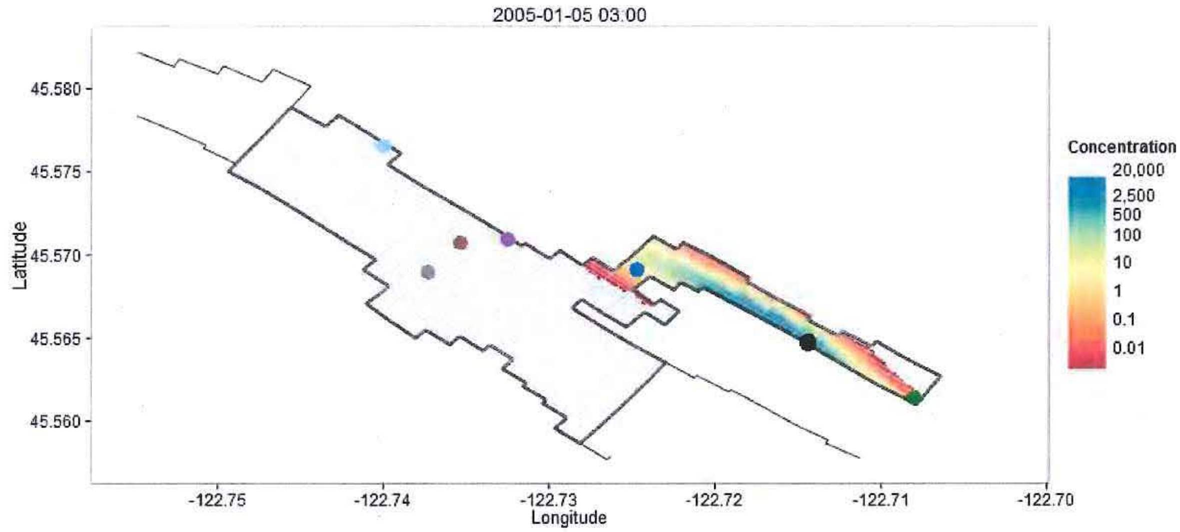

Figure 33: IL7 - 1 day after the dye slug injection.

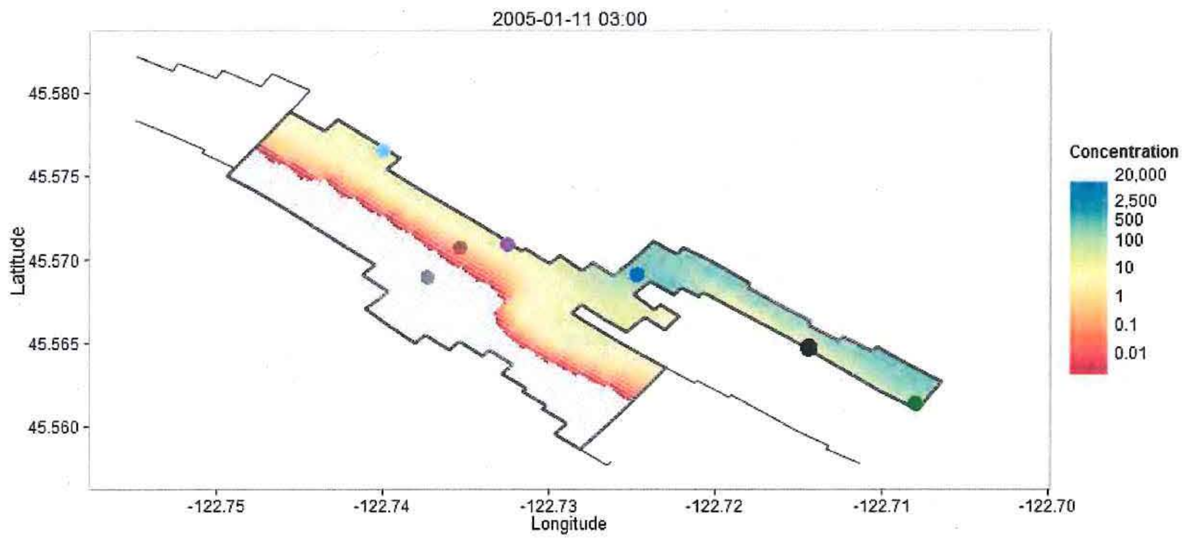

Figure 34: IL7 - 1 week after the dye slug injection.

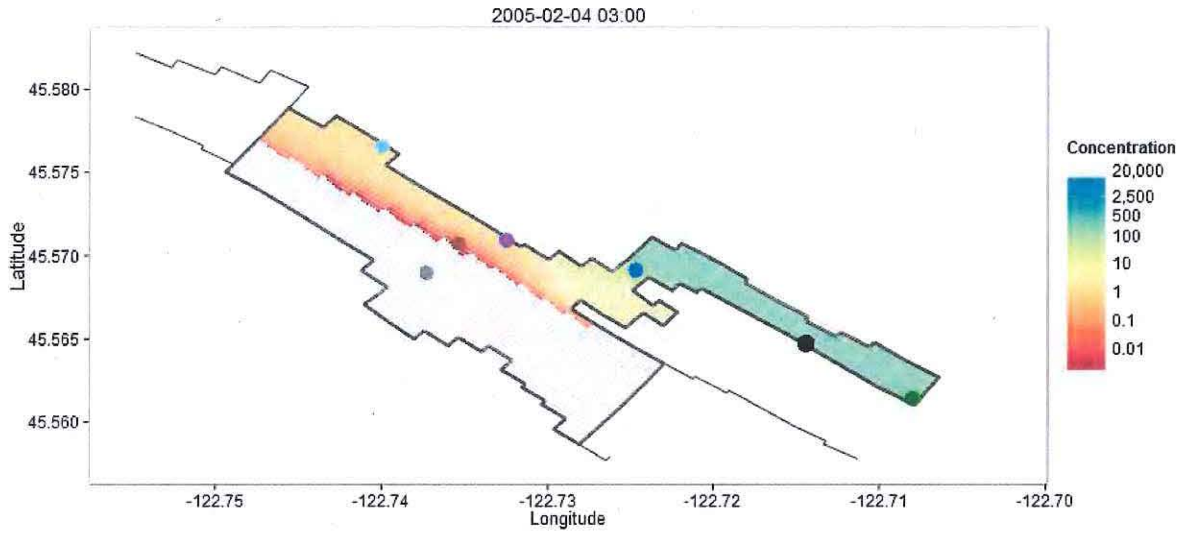

Figure 35: IL7 - 1 month after the dye slug injection.

Dye Injection Location #10

Figure 36 shows the four model cell locations where modeled dye concentration results were analyzed including the dye injection Location #10 (IL10) that corresponds to the BWTP outfall location, represented by the black dot in the figure. The salmon colored area represents the spatial domain analyzed from the model output.

Figure 36: IL10 - Model cell locations of individual dye concentration time-series and associated plot colors.

Figure 37 shows the time-series of the dye concentrations at each of the four model cell locations. The black line plot in the upper left of the figure shows the dye concentration at the injection location and shows the spike in concentration over the 48 hour release period. At the entrance of the Lagoon there is a short term spike in the dye concentration approximately one to two days after the injection that gradually decreases over time. The gradual decrease is due to tidal cycling. After reaching the entrance of the Lagoon, it took approximately four days before dye was transported to the head of the Lagoon as shown in the upper right plot. The dye concentrations at the head of the Lagoon are orders of magnitude lower than in the main stem of the Willamette River, but persist for a much longer period.

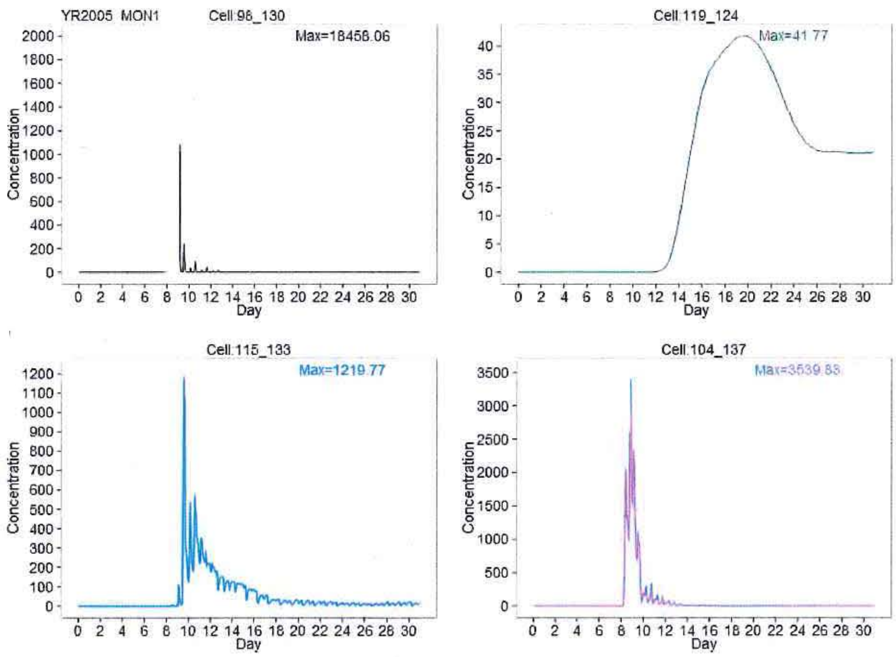

Figure 37: IL10 - Individual model cell dye concentration time-series.

Figure 38 shows the highest dye concentrations are in the main stem River and entrance to the Lagoon and dissipates quickly over space. The plume clearly hugs the east bank of the Willamette River and does not go very far upstream from the injection point (black dot). The time series plots show the impacts of the tidal forcing causing the dye concentration at several locations to increase and decrease over time.

After the first day after the injection, the dye plume had expanded down into the Lagoon but the concentrations in the main stem of the River decreased by approximately 84% from 830 units to 130 units in the eastern half of the River, as shown in Figure 39. The plume has spread across the River, resulting in low concentrations during a flood tide and was then subsequently flushed from the western half of the River with the ebb tide. The few remaining areas with concentrations on the west bank are on the order of 0.001 units.

After one week the dye had spread longitudinally down the Lagoon but not transversely across the main stem of the River, as shown in Figure 40. After one month, the spatial pattern of the dye plume had not changed but the dye concentrations continued to dissipate, as seen in comparing Figures 40 and 41.

Conclusion: A limited potential for the movement of dye into the Lagoon exists. Once the dye reaches the entrance of the Lagoon, it took approximately four days for the dye to reach the head of the Lagoon, a distance of approximately 5,000 feet. The majority of the dye was transported quickly downstream the main stem along the northeastern bank.

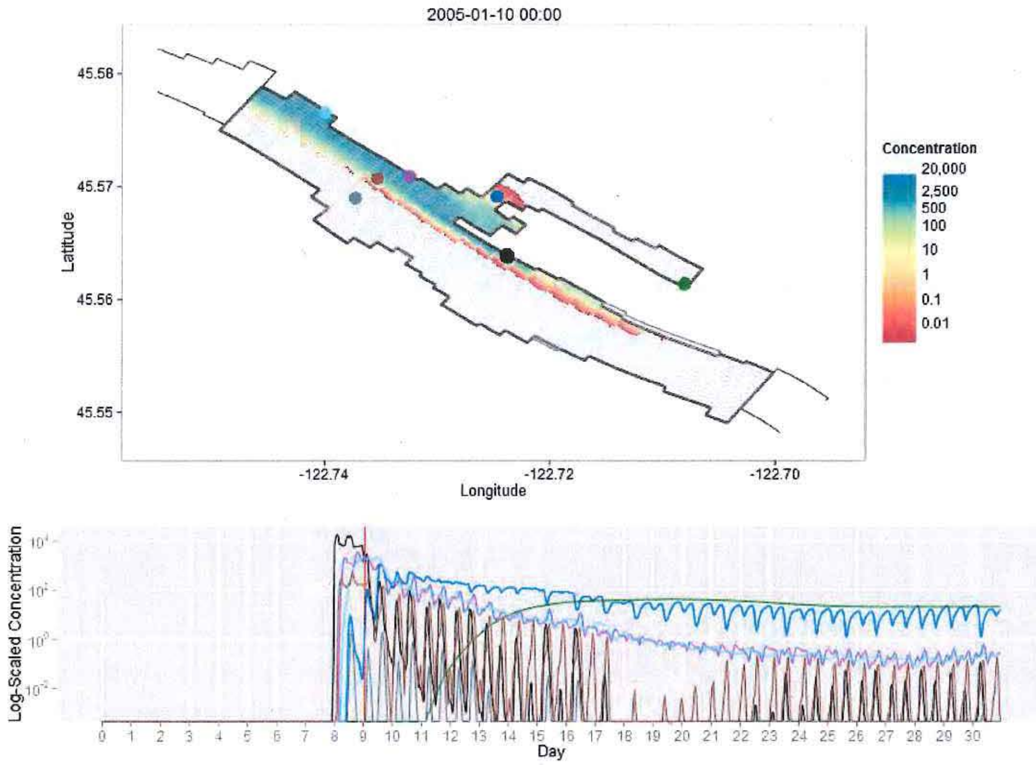

Figure 38: IL10 - End of 2 day dye slug injection.

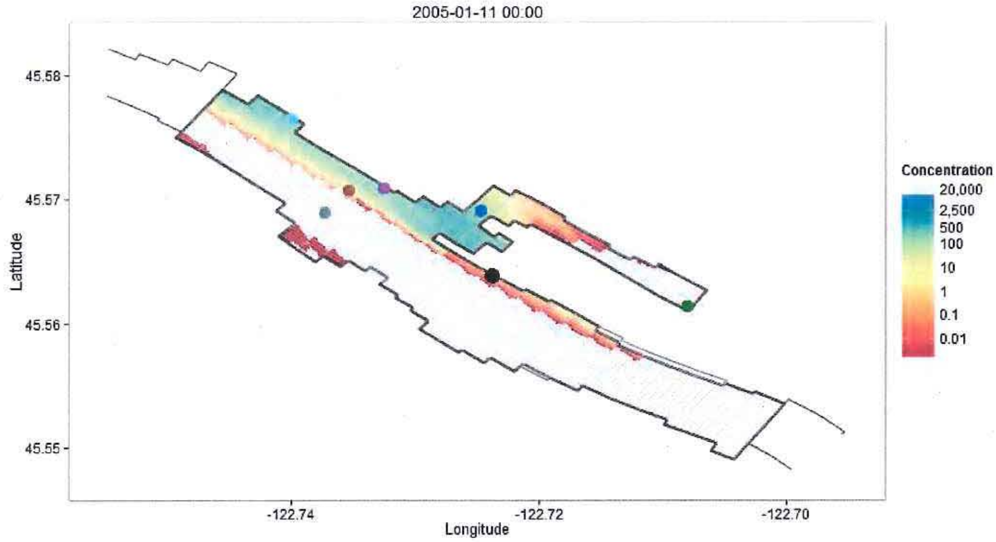

Figure 39: IL10 - 1 day after the dye slug injection.

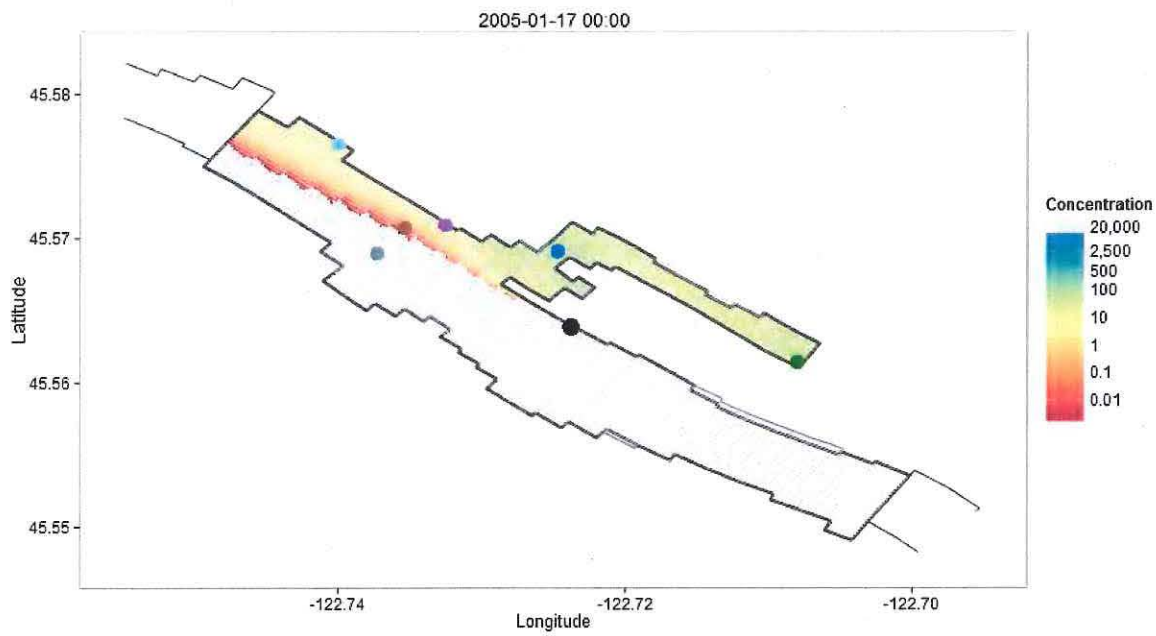

Figure 40: IL10 - 1 week after the dye slug injection.

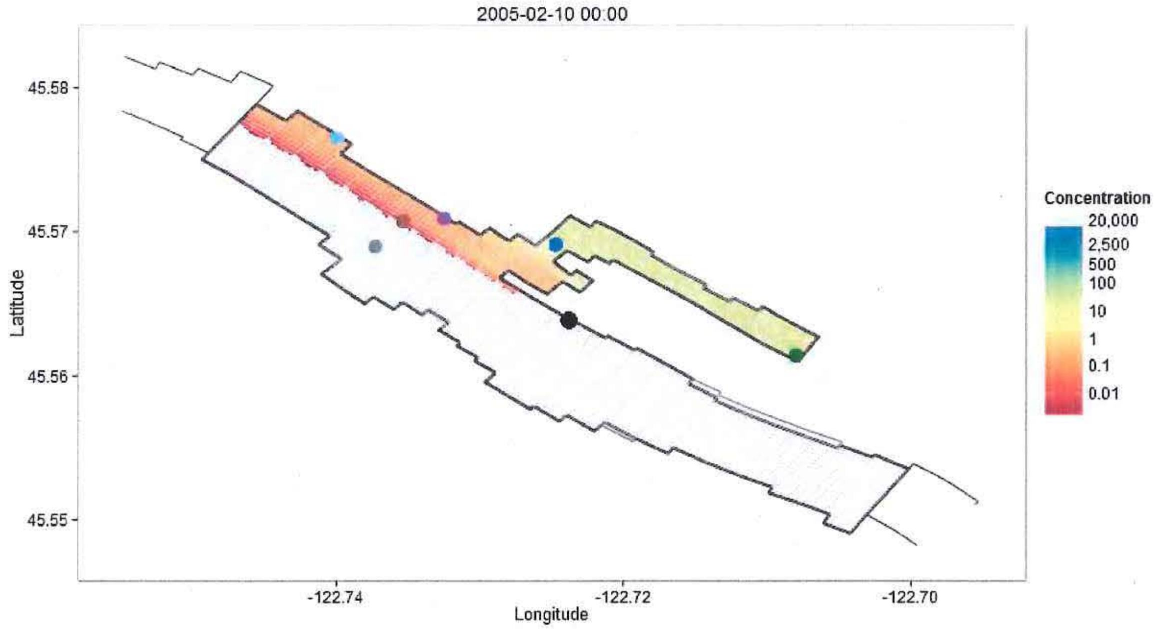

Figure 41: IL10 - 1 month after the dye slug injection.

CONCLUSIONS

The type of flow regime significantly altered the simulated average dye concentration in the Lagoon, with concentrations being the greatest during the medium flow regime. The temporal patterns of the dye concentration within the Lagoon were more similar between the low and high flow regimes, whereas those within the main stem of the Willamette River were more similar between the low and medium flow regimes. The tidal cycle has a noticeable effect on the hydrodynamics and, as a result, the transport of the dye within the Lagoon and the main stem of the Willamette River. The flow within the main stem of the River during the high flow regime was great enough to limit almost all transverse mixing, rapidly transporting the dye downstream along the northeast bank of the River.

Under the different flow regimes and injection locations studied, the dye was transported downstream along the northeast bank of the Willamette River. The flow of the River limited the degree of local transverse mixing, and dye was rarely transported beyond the mid-channel. The largest differences in dispersion of the dye between the injection locations were whether the injection location was within the main stem of the Willamette River or the Lagoon itself. If the dye was injected into the main stem of the Willamette River, it was quickly transported downstream along the northeastern River bank with only minor amounts of dye forced into the Lagoon during high flood tides. This occurred whether the injection location was upstream or downstream of the entrance of the Lagoon. However, if the dye was injected into the Lagoon, it exhibited a tendency to persist in the Lagoon in small concentrations relative to the amount injected. In the case of IL1, the hypothetical outfall on the main stem of the River and downstream of the Lagoon's entrance, approximately 85% of the dye within the study area had been transported out of the study area after one day. In contrast, an overall reduction of only approximately 25% was simulated after one day for IL2, the private outfall just inside the entrance of the Lagoon. Furthermore, after one month, the average dye concentration within the Lagoon, at the Lagoon's entrance, and within the main stem of the Willamette River were approximately 5 units, 1 unit, and 0.01 units, respectively, when the dye was injected into the main stem at IL1. These average concentrations rose to 290 units, 15 units, and 1 unit, respectively, when the injection location moved to within the Lagoon at IL2. The other injection locations within the Lagoon (IL3 – 8) produced similar average concentrations as IL2.

However, the Model only simulated neutrally buoyant dye particles with no settling velocities. Therefore, the slow water velocities found within the Lagoon can temporarily or, in the case of particles with higher settling velocities, permanently trap introduced suspended particles. If the particles were allowed to settle, the majority of non-cohesive particle sizes would likely settle out within the Lagoon.

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REFERENCES

Annear, R., P. Hobson, and B. Apple. (2014). *Confidential Technical Memorandum – Hydrodynamic Scenarios to Assess Depositional Nature in the Lagoon*. July 2014.

Vogt, L. (2002). *Swan Island Industrial Park: Storm Water Basin Maps – Site Plan*. Modified on March 4, 2004. October 2002.

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APPENDIX A

DYE INJECTION LOCATION #4

Figure 42: IL4 - Model cell locations of individual dye concentration time-series and associated plot colors.

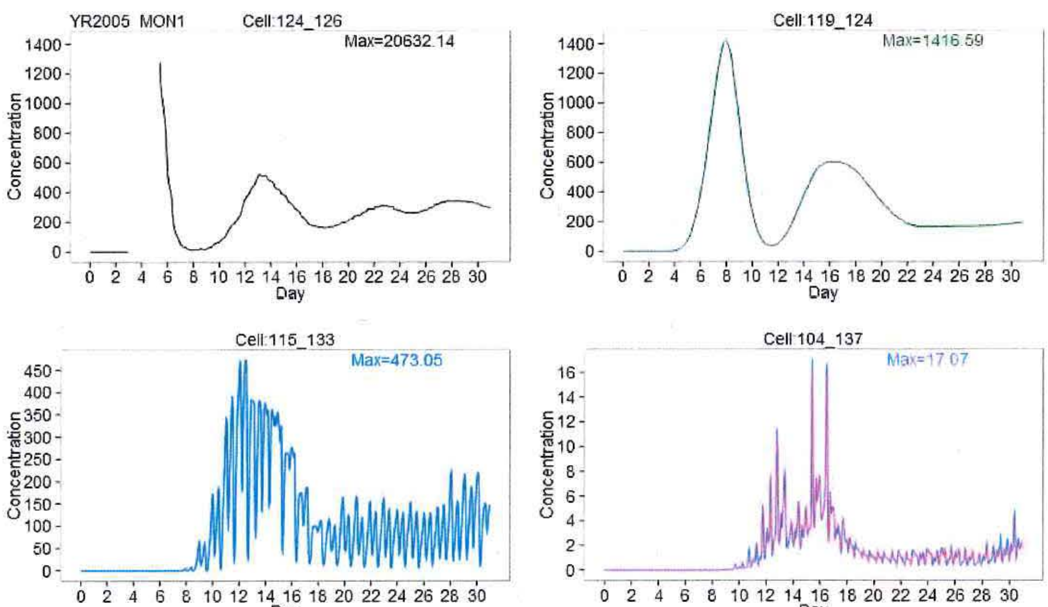

Figure 43: IL4 - Individual model cell dye concentration time-series.

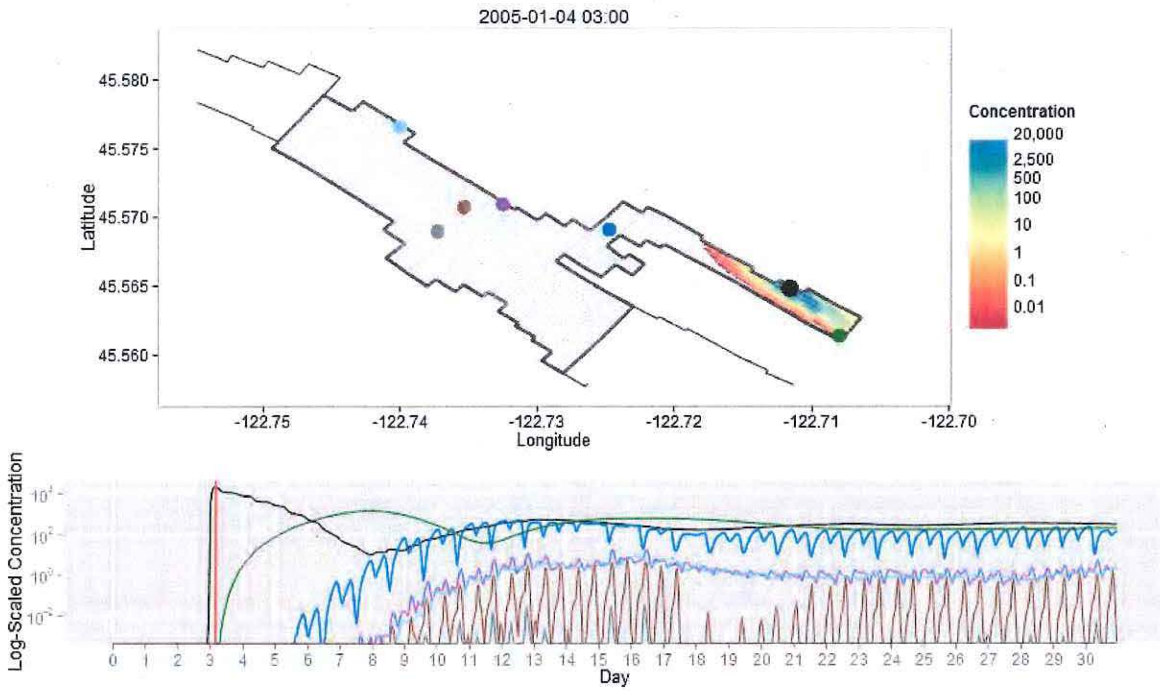

Figure 44: IL4 - End of 3hr dye slug injection.

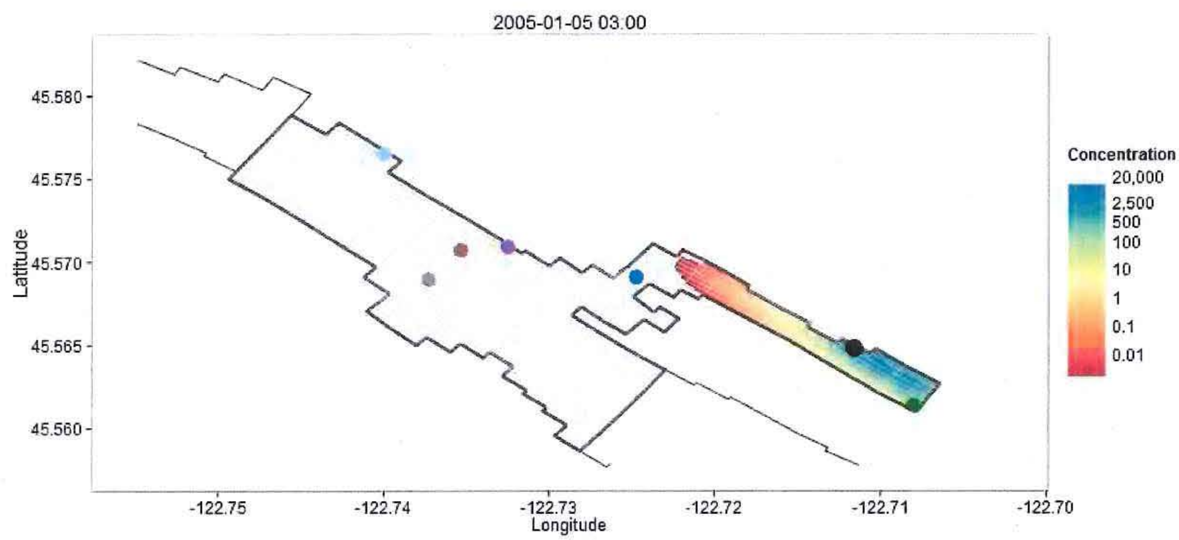

Figure 45: IL4 - 1 day after the dye slug injection.

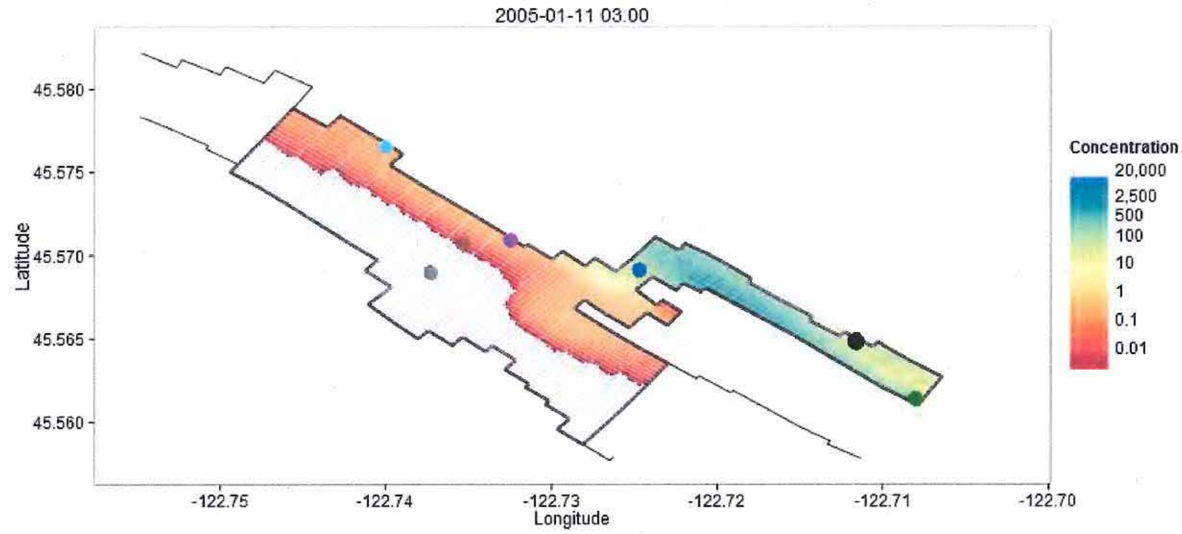

Figure 46: IL4 - 1 week after the dye slug injection.

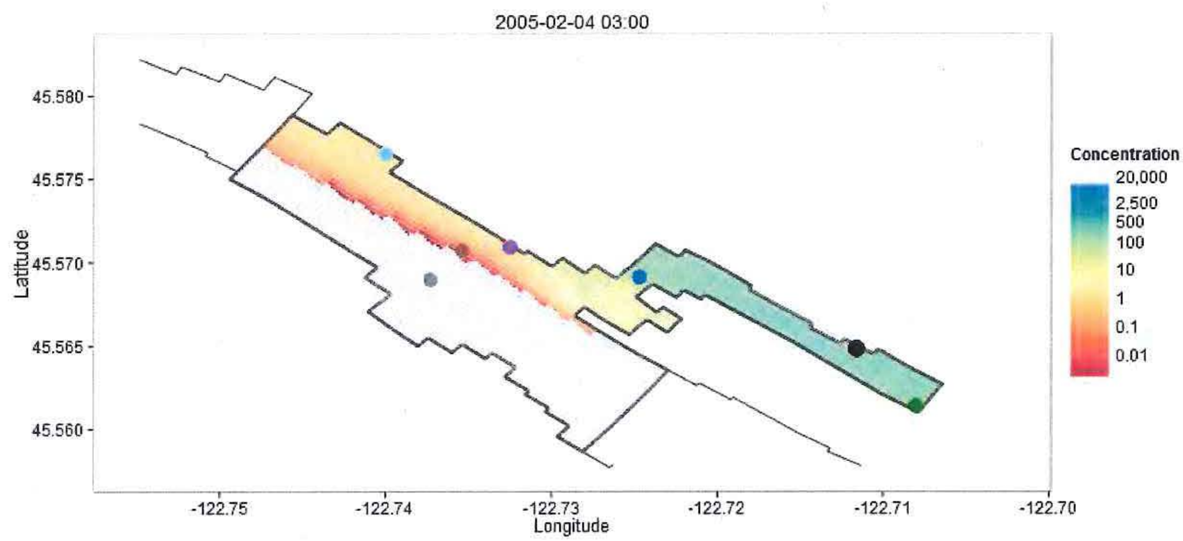

Figure 47: IL4 - 1 month after the dye slug injection.

Dye Injection Location #5

Figure 48: IL5 - Model cell locations of individual dye concentration time-series and associated plot colors.

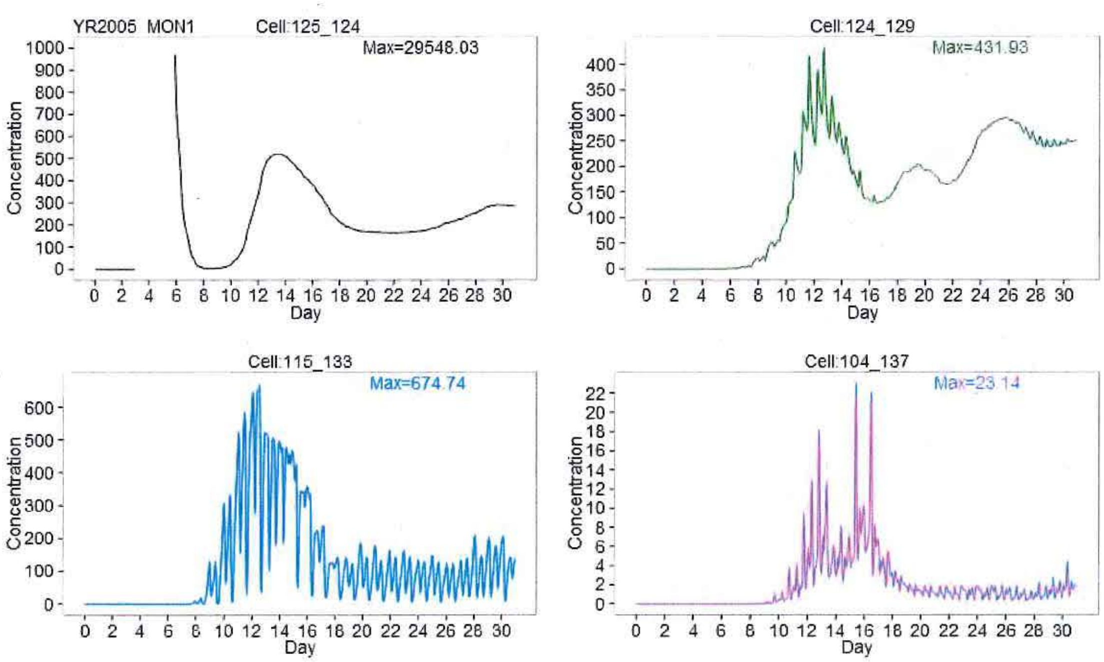

Figure 49: IL5 - Individual model cell dye concentration time-series.

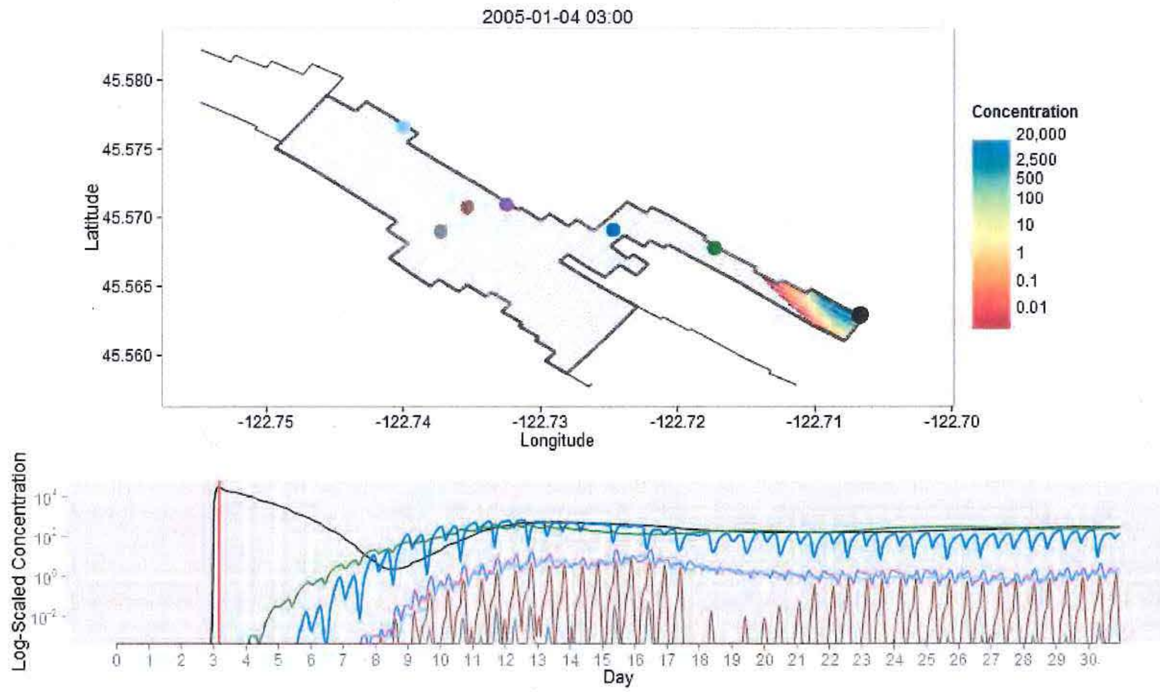

Figure 50: IL5 – End of 3hr dye slug injection.

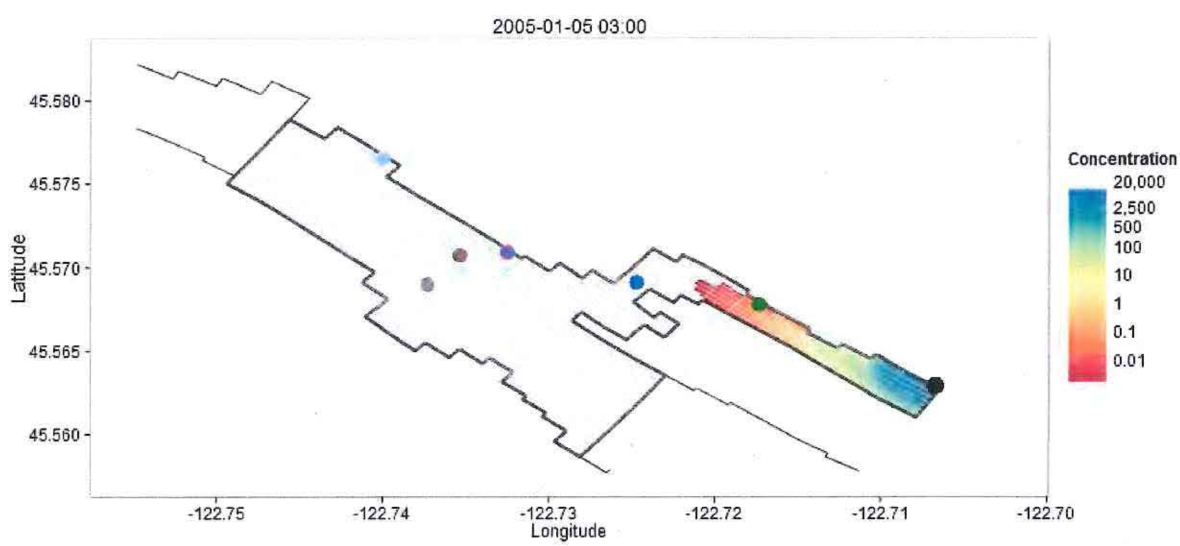

Figure 51: IL5 - 1 day after the dye slug injection.

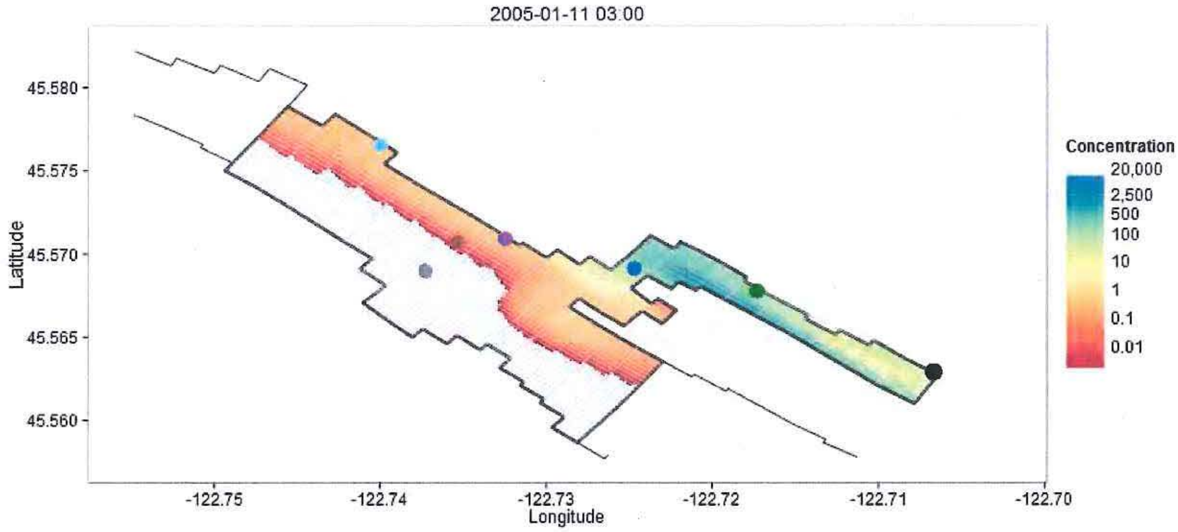

Figure 52: IL5 - 1 week after the dye slug injection.

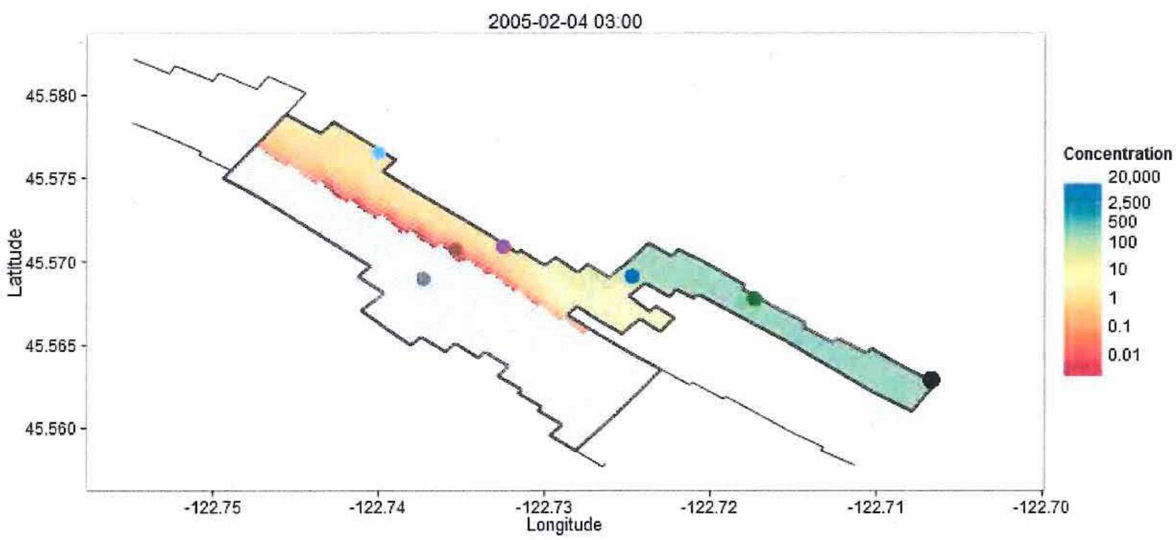

Figure 53: IL5 - 1 month after the dye slug injection.

Dye Injection Location #6

Figure 54: IL6 - Model cell locations of individual dye concentration time-series and associated plot colors.

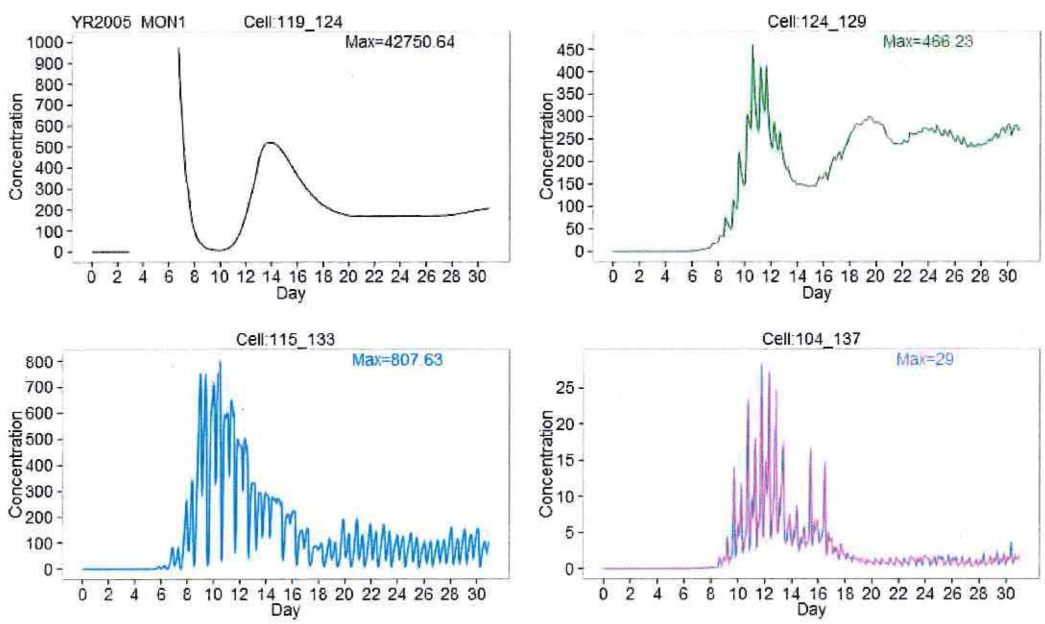

Figure 55: IL6 - Individual model cell dye concentration time-series.

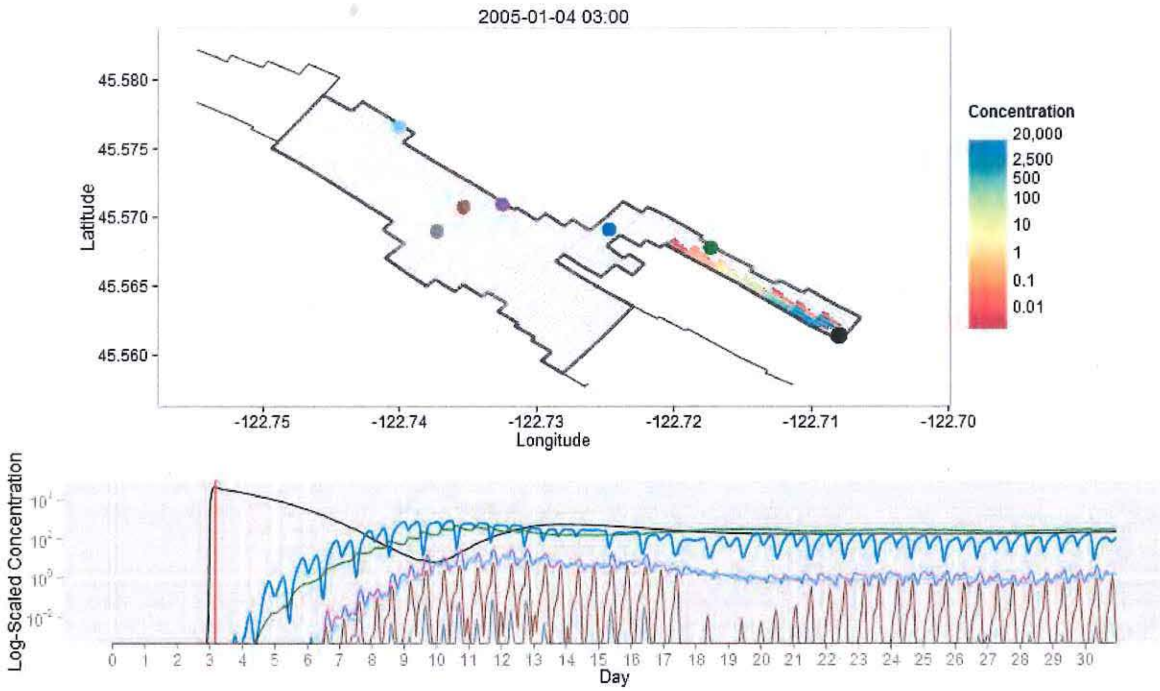

Figure 56: IL6 - End of 3hr dye slug injection.

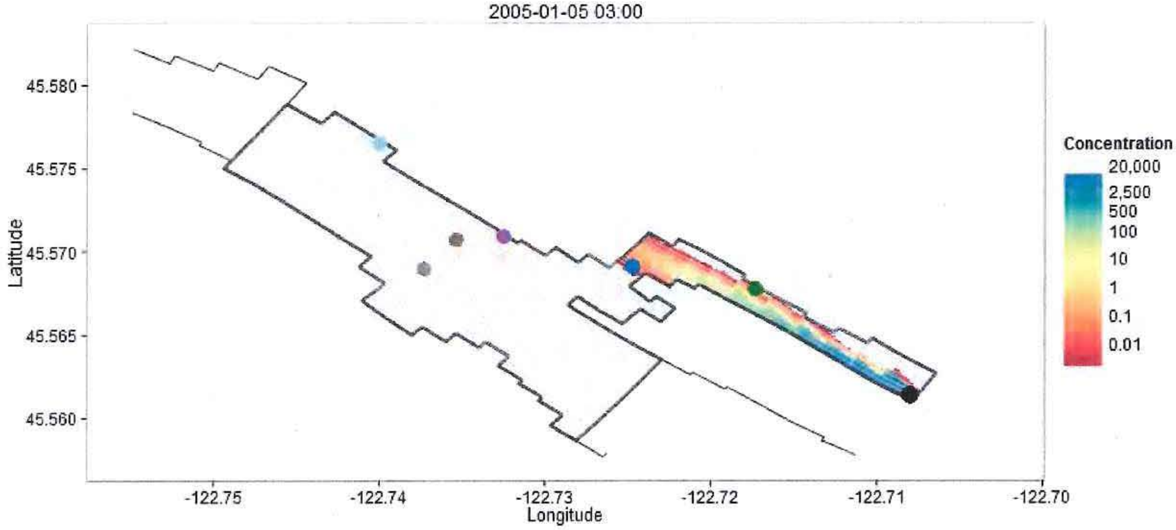

Figure 57: IL6 - 1 day after the dye slug injection.

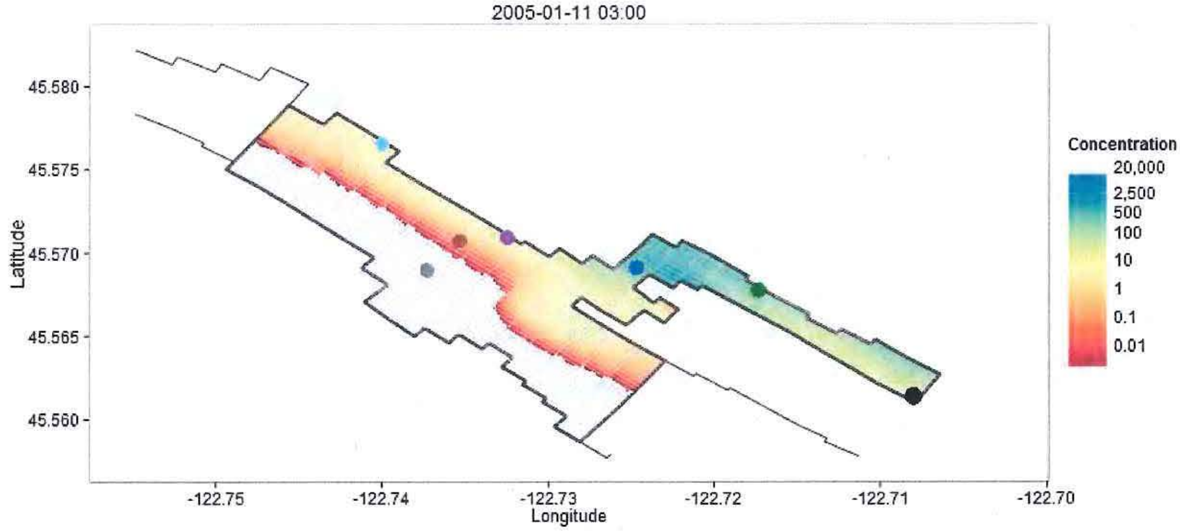

Figure 58: IL6 - 1 week after the dye slug injection.

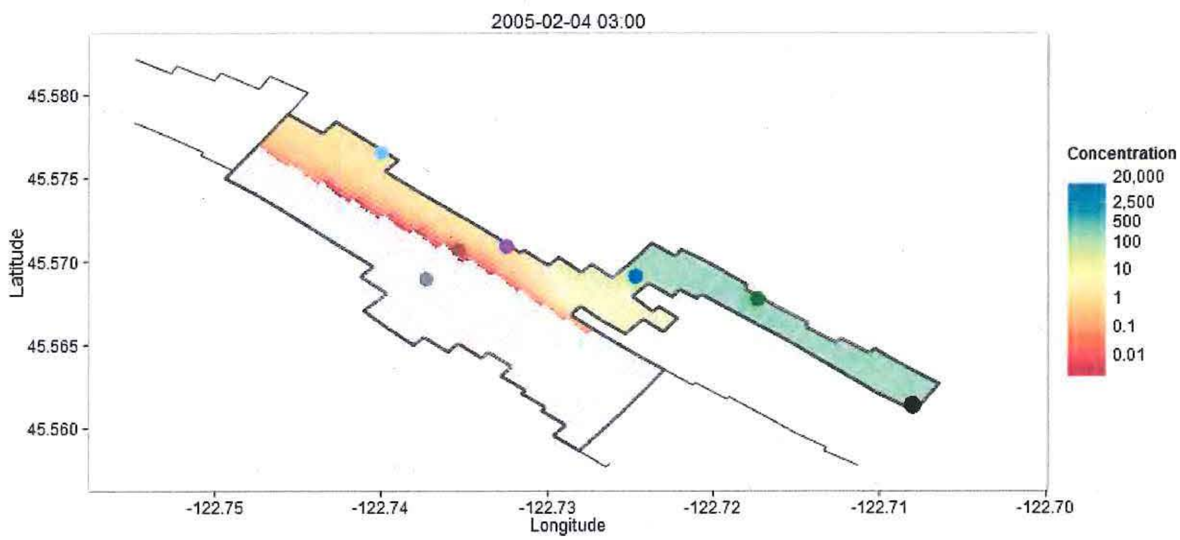

Figure 59: IL6 - 1 month after the dye slug injection.

Dye Injection Location #8

Figure 60: IL8 - Model cell locations of individual dye concentration time-series and associated plot colors.

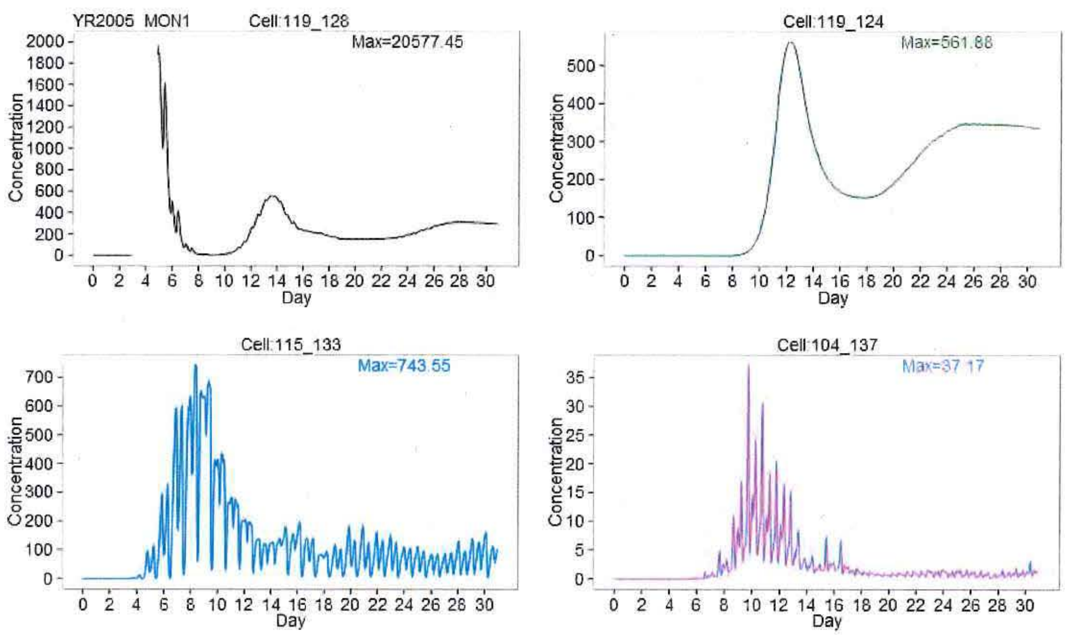

Figure 61: IL8 - Individual model cell dye concentration time-series.

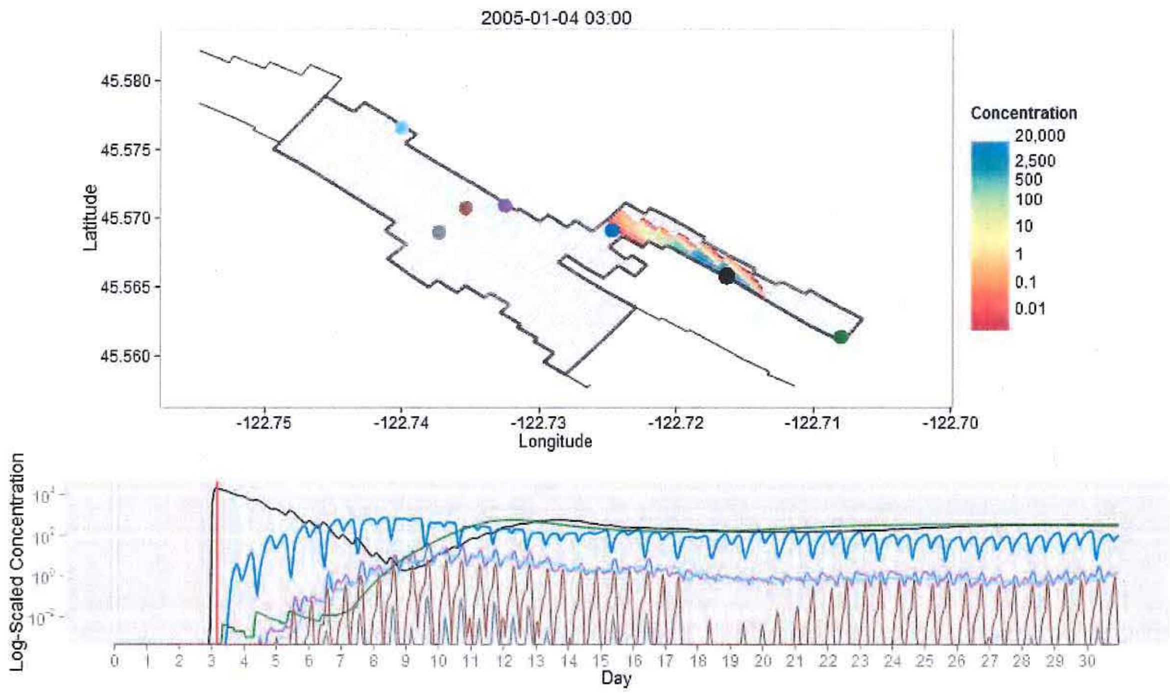

Figure 62: IL8 - End of 3hr dye slug injection.

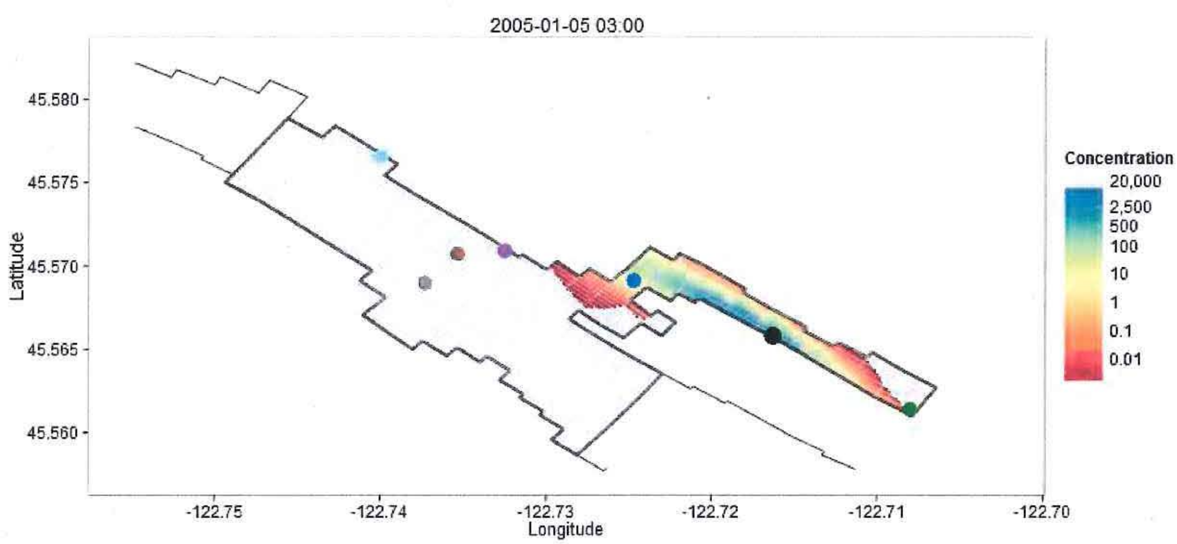

Figure 63: IL8 - 1 day after the dye slug injection.

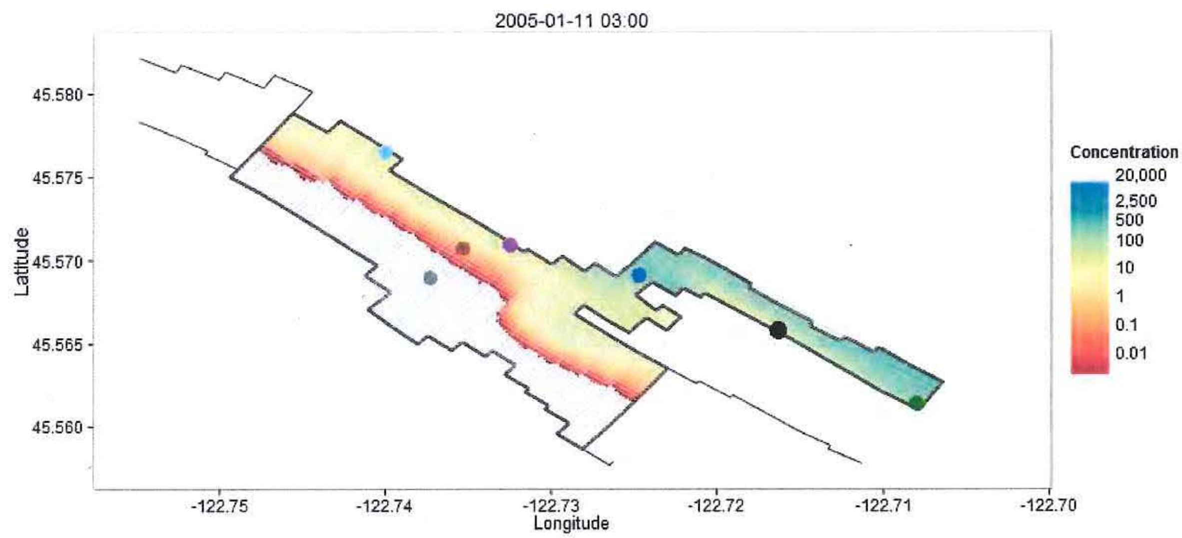

Figure 64: IL8 - 1 week after the dye slug injection.

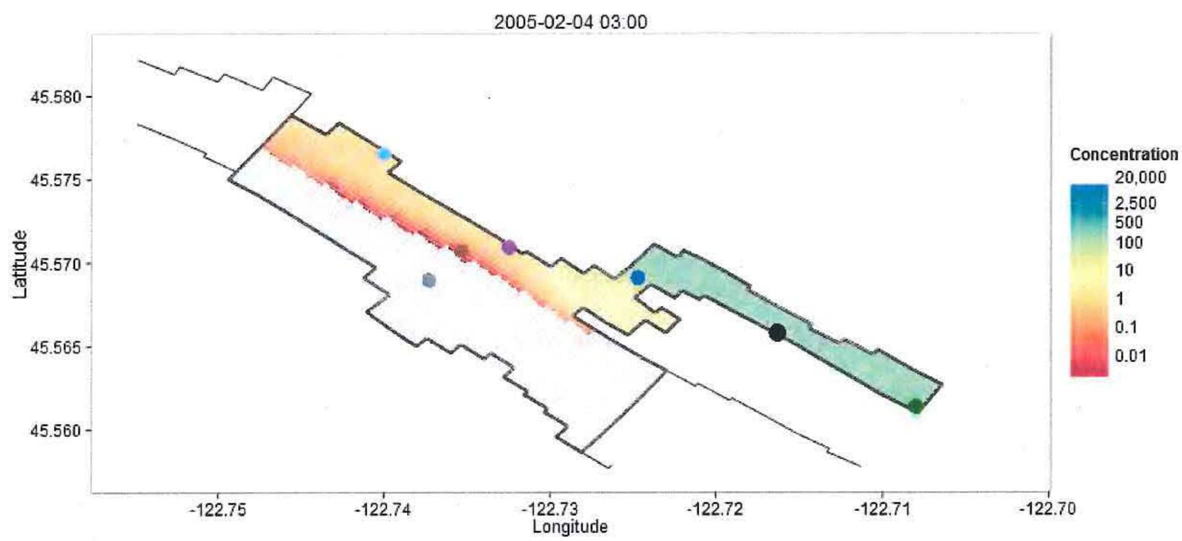

Figure 65: IL8 - 1 month after the dye slug injection.

Dye Injection Location #9

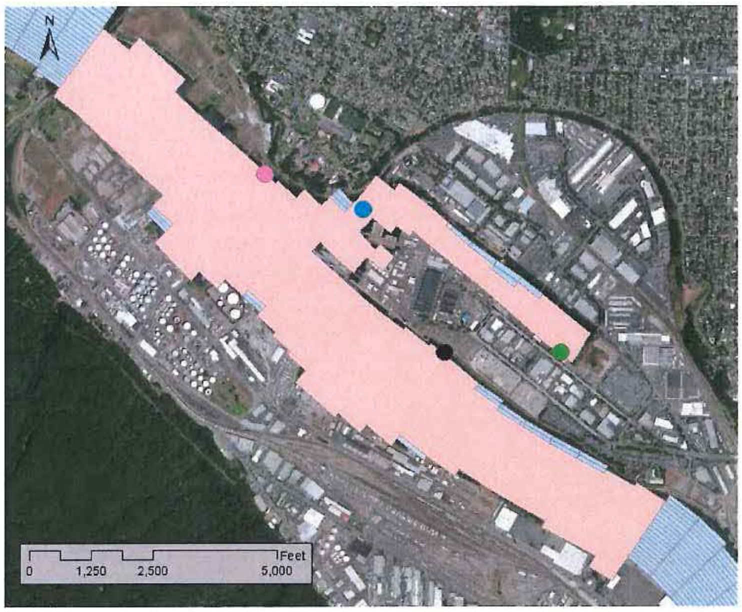

Figure 66: IL9 - Model cell locations of individual dye concentration time-series and associated plot colors.

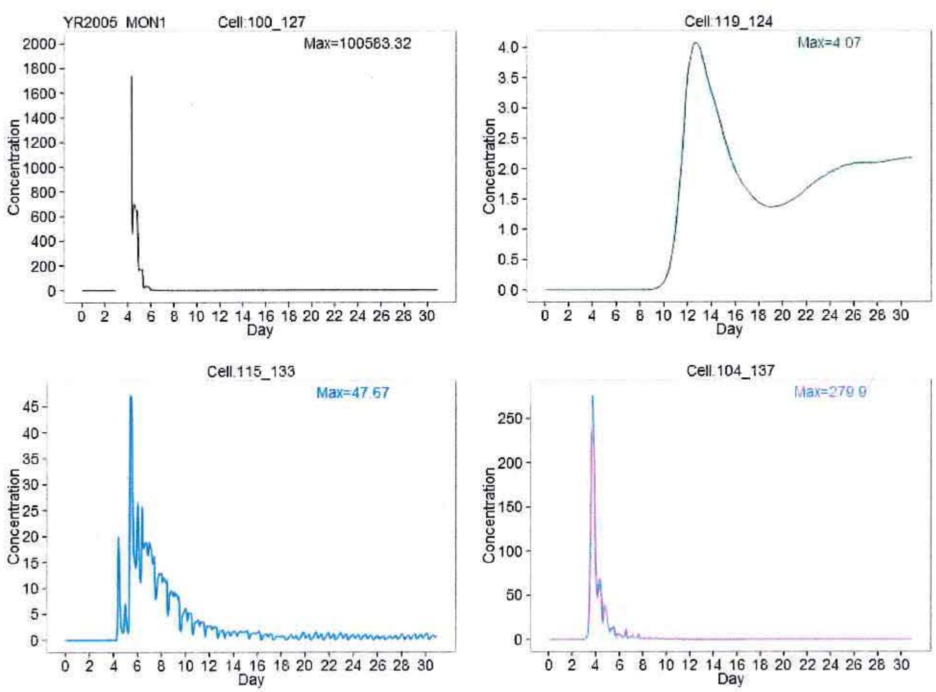

Figure 67: IL9 - Individual model cell dye concentration time-series.

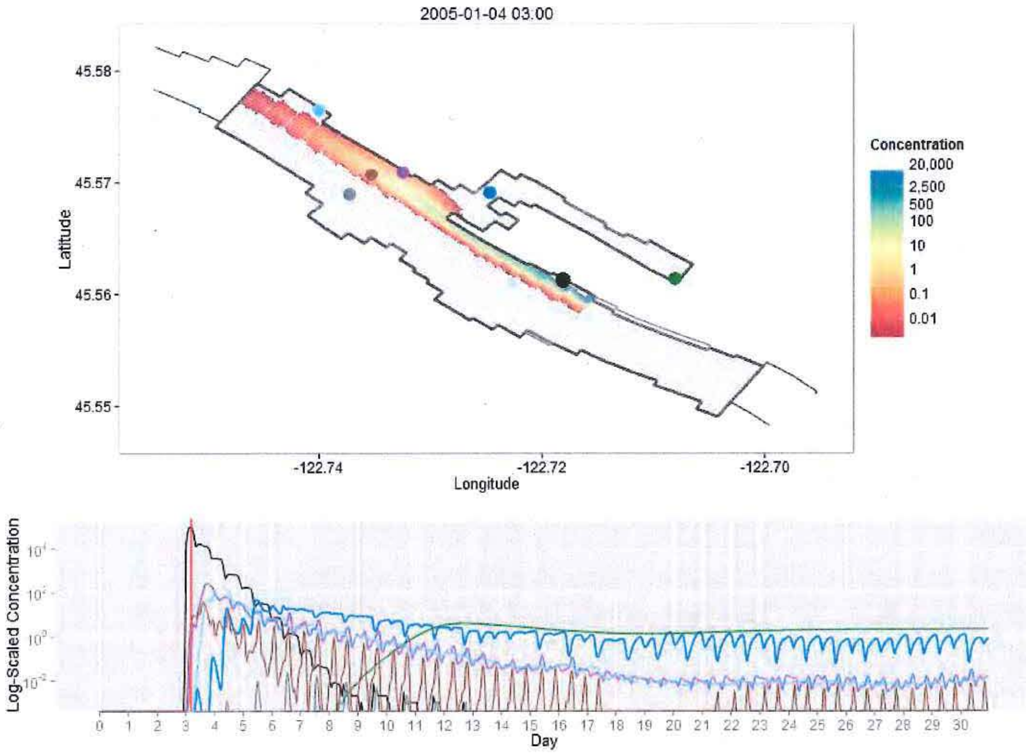

Figure 68: IL9 – End of 3hr dye slug injection.

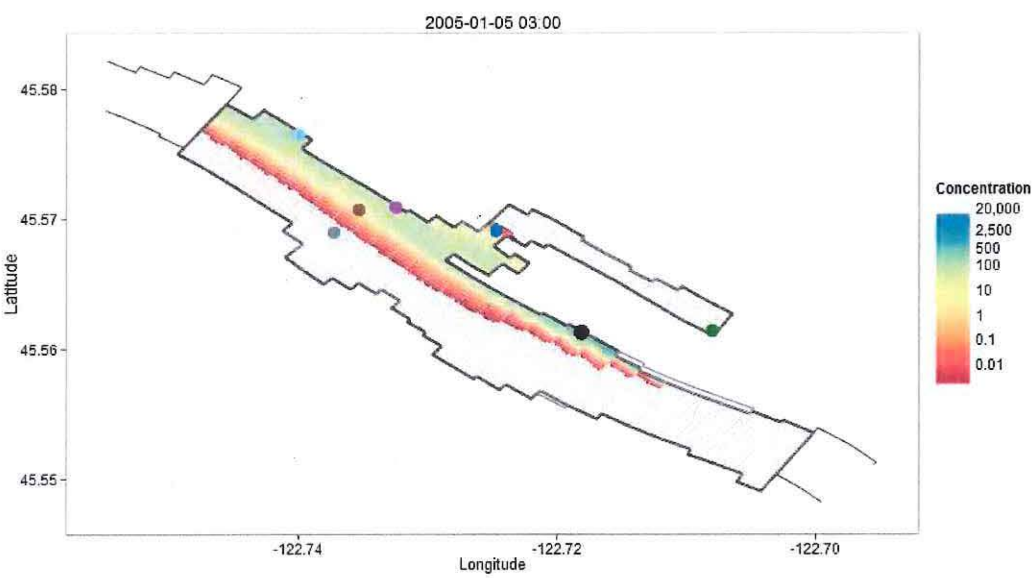

Figure 69: IL9 - 1 day after the dye slug injection.

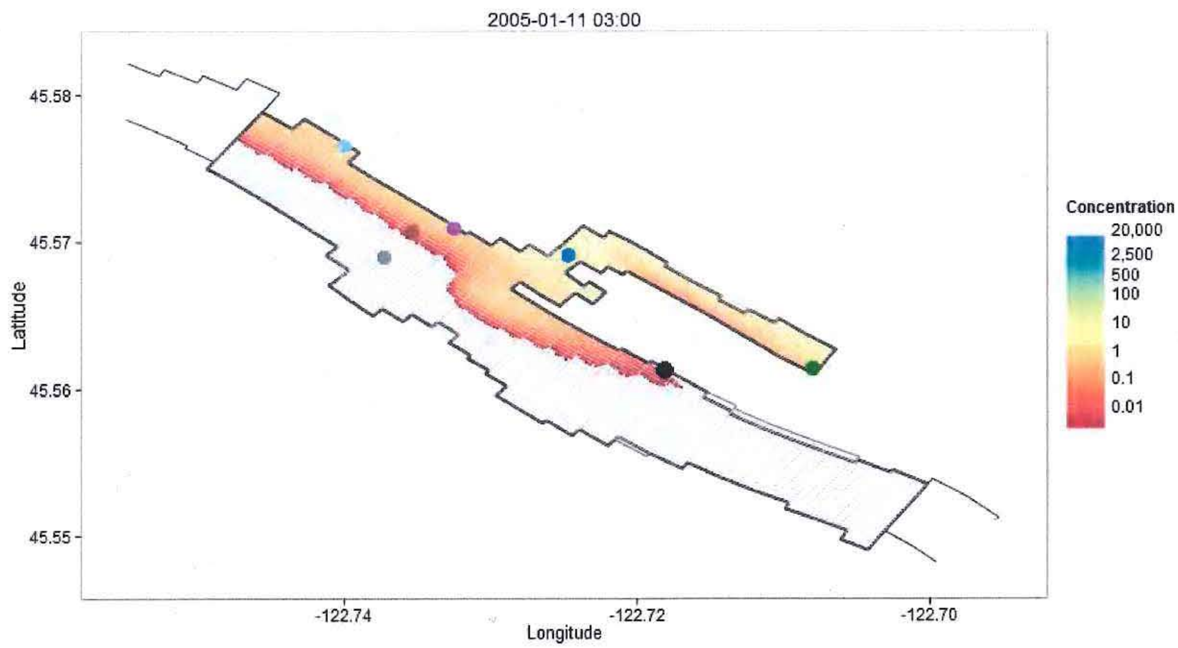

Figure 70: IL9 - 1 week after the dye slug injection.

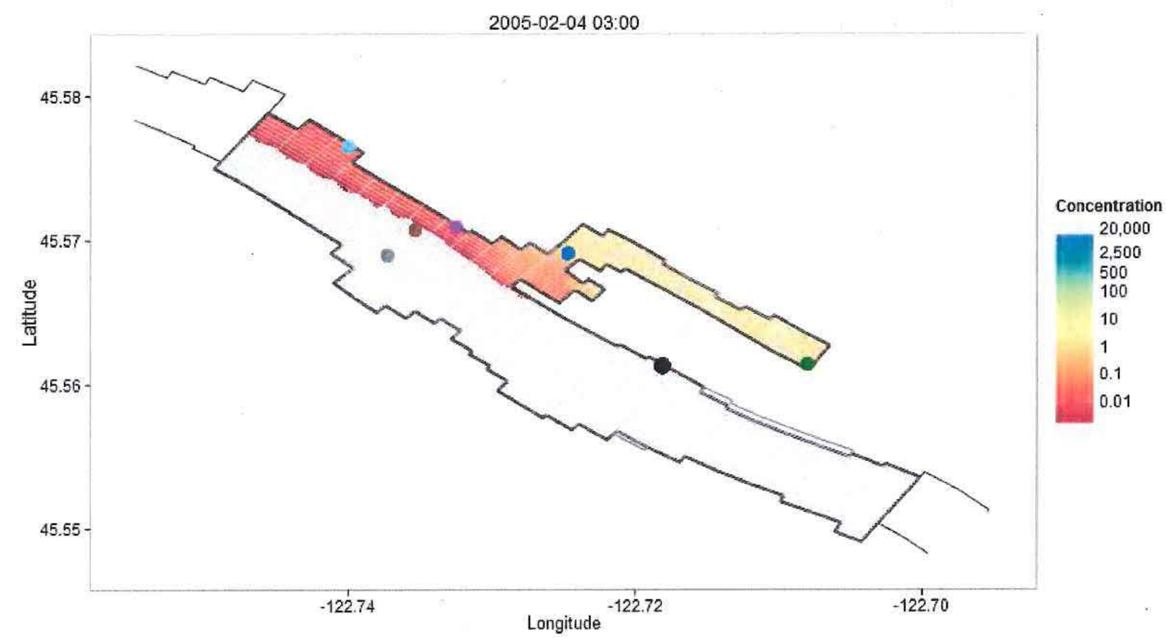

Figure 71: IL9 - 1 month after the dye slug injection.

Geosyntec consultants

APPENDIX C

Surface Sediment Sample Datasheets

Surface Sediment Sample Datasheet

Project Information		
Project: HPH100D	Sampling Method:	Contractor: Ballard
Date: ~~3/3/16~~ 3/4/16	VanVeen grab sampler	Sample Team: KK, AC

Sample Location	
Mill Area:	Description of Location and Channel Bottom: near dry docks
Subarea:	
Station:	

Sample Collection and Description

Sample ID: SIL ~~[illegible]~~ - 00	Containers: 2 (8 oz glass jar)	Sample Time: 11:35

Sediment Type (e.g., silt, sand)

Texture (e.g., fine-grain, poorly sorted)

Stratification, if any

Color (Munsell color scale) brown to gray soft silt over soft to stiff clayey silt

Moisture

Presence/location/thickness of Redox Potential Discontinuity Layer (a visual indication of black)

Presence (and %) of biological structures (e.g., chironomids, tubes, macrophytes), organic debris (e.g., twigs, leaves), shells

no debris, no odor, no sheen

Odor/Sheen Evaluation:

Observed (Y/N) N Color:____ Swirl Test:____ Odor:____ SudanIV (Y/N):____ UV Light (Y/N):____

Attempt 1

Time: 11:29	Photo Number:	Successful (circle one)
Penetration Depth (cm): 0-30	Water Depth: ~~43.4~~ 55.7	Rejected
GPS Coordinates: N 45.~~4~~56848, W 122.72410		
Comment: offset 25 ft due to boom, sampler did not seal		

Attempt 2

Time: 11:35	Photo Number:	Successful (circle one)
Penetration Depth (cm): 0-30	Water Depth: 55.7	Rejected
GPS Coordinates: N 45.56857, W 122.72395		
Comment:		

Attempt 3

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Surface Sediment Sample Datasheet

Project Information		
Project: HPH100D	Sampling Method:	Contractor: Ballard
Date: ~~3/3/16~~ 3/4/16	VanVeen grab Sampler	Sample Team: KK, AC

Sample Location	
Mill Area:	Description of Location and Channel Bottom:
Subarea:	
Station:	

Sample Collection and Description		
Sample ID: SIL - 01	Containers: 2 (8 oz glass jar)	Sample Time: 11:48

Sediment Type (e.g., silt, sand)
Texture (e.g., fine-grain, poorly sorted)
Stratification, if any
Color (Munsell color scale)
Moisture
brown to gray soft Silt over soft to stiff clayey silt with sand lens
Presence/location/thickness of Redox Potential Discontinuity Layer (a visual indication of black)

Presence (and %) of biological structures (e.g., chironomids, tubes, macrophytes), organic debris (e.g., twigs, leaves), shells
Sheen, small metal bits, no odor

Odor/Sheen Evaluation:
Observed (Y/N) Y Color:____ Swirl Test:____ Odor:____ SudanIV (Y/N):____ UV Light (Y/N):____

Attempt 1

Time: 11:48	Photo Number:	Successful (circle one)
Penetration Depth (cm): 0-30	Water Depth: ~~41~~ 40.3	Rejected
GPS Coordinates: N 45.56887, W 122.72283		
Comment:		

Attempt 2

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Attempt 3

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Surface Sediment Sample Datasheet

Project Information		
Project: HPH100D	Sampling Method:	Contractor: Ballard
Date: ~~3/3/16~~ 3/4/16	VanVeen grab Sampler	Sample Team: KK, AC
Sample Location		
Mill Area:	Description of Location and Channel Bottom:	
Subarea:		
Station:		
Sample Collection and Description		
Sample ID: SIL-02	Containers: 2 (8 oz glass jar)	Sample Time: 11:20

Sediment Type (e.g., silt, sand)
Texture (e.g., fine-grain, poorly sorted)
Stratification, if any
Color (Munsell color scale) brown to gray soft silt over soft to
Moisture stiff clayey silt
Presence/location/thickness of Redox Potential Discontinuity Layer (a visual indication of black)

Presence (and %) of biological structures (e.g., chironomids, tubes, macrophytes), organic debris (e.g., twigs, leaves), shells
Sheen, some woody debris, petro. odor

Odor/Sheen Evaluation:
Observed (Y/N) Y Color:____ Swirl Test:____ Odor:____ SudanIV (Y/N):____ UV Light (Y/N):____

Attempt 1

Time: 11:20	Photo Number:	Successful (circle one)
Penetration Depth (cm): 0-30	Water Depth: 34.6	Rejected
GPS Coordinates: N 45.57007, W 122.72295		
Comment:		

Attempt 2

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Attempt 3

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Surface Sediment Sample Datasheet

Project Information		
Project: HPH100D	Sampling Method:	Contractor: Ballard
Date: ~~3/3/16~~ 3/14/16	VanVeen grab sampler	Sample Team: KK, AC

Sample Location	
Mill Area:	Description of Location and Channel Bottom:
Subarea:	
Station:	

Sample Collection and Description		
Sample ID: SIL-03	Containers: 2 (8 oz glass jar)	Sample Time: 11:14

Sediment Type (e.g., silt, sand)

Texture (e.g., fine-grain, poorly sorted)

Stratification, if any

Color (Munsell color scale) brown to gray soft silt over silty sand

Moisture to soft sandy silt

Presence/location/thickness of Redox Potential Discontinuity Layer (a visual indication of black)

Presence (and %) of biological structures (e.g., chironomids, tubes, macrophytes), organic debris (e.g., twigs, leaves), shells

Some woody debris, no sheen, no odor

Odor/Sheen Evaluation:

Observed (Y/N) N Color:____ Swirl Test:____ Odor:____ SudanIV (Y/N):____ UV Light (Y/N):____

Attempt 1

Time: 11:14	Photo Number:	Successful (circle one)
Penetration Depth (cm): 0-30	Water Depth: 26.3	Rejected
GPS Coordinates: N 45.57043, W 122.72304		
Comment:		

Attempt 2

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Attempt 3

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Surface Sediment Sample Datasheet

Project Information		
Project: HPH1OOD	Sampling Method:	Contractor: Ballard
Date: ~~3/3/10~~ 3/4/10	VanVeen grab sampler	Sample Team: KK, AC
Sample Location		
Mill Area:	Description of Location and Channel Bottom:	
Subarea:		
Station:		
Sample Collection and Description		
Sample ID: SIL [redacted] - 04	Containers: 2 (8 oz glass jar)	Sample Time: 11:03

Sediment Type (e.g., silt, sand)

Texture (e.g., fine-grain, poorly sorted)

Stratification, if any

Color (Munsell color scale) brown soft silt over gray sand

Moisture

Presence/location/thickness of Redox Potential Discontinuity Layer (a visual indication of black)

Presence (and %) of biological structures (e.g., chironomids, tubes, macrophytes), organic debris (e.g., twigs, leaves), shells

some rocks; no odor, no sheen, some woody debris

Odor/Sheen Evaluation:

Observed (Y/N) N Color:____ Swirl Test:____ Odor:____ SudanIV (Y/N):____ UV Light (Y/N):____

Attempt 1

Time: 10:57	Photo Number:	Successful (circle one)
Penetration Depth (cm): 0 - 30	Water Depth: 12.5	Rejected
GPS Coordinates: N 45.57053, W 122.72182		
Comment: coarse sand, less than 1/2 full		

Attempt 2

Time: 11:00	Photo Number:	Successful (circle one)
Penetration Depth (cm): 0 - 30	Water Depth: 12.5	Rejected
GPS Coordinates: N 45.57053, W 122.72182		
Comment: coarse sand, less than 1/2 full		

Attempt 3

Time: 11:03	Photo Number:	Successful (circle one)
Penetration Depth (cm): 0 - 30	Water Depth: 12.7	Rejected
GPS Coordinates: N 45.57048 W 122.72184		
Comment: moved		

Surface Sediment Sample Datasheet

Project Information		
Project: HPH100D	Sampling Method:	Contractor: Ballard
Date: ~~3/3/16~~ 3/4/16	VanVeen grab sampler	Sample Team: KK, AC
Sample Location		
Mill Area:	Description of Location and Channel Bottom:	
Subarea:		
Station:		
Sample Collection and Description		
Sample ID: SIL - 05	Containers: 2 (8 oz glass jar)	Sample Time: 10:51

Sediment Type (e.g., silt, sand)

Texture (e.g., fine-grain, poorly sorted)

Stratification, if any

Color (Munsell color scale) brown to gray soft silt over soft to stiff

Moisture clayey silt

Presence/location/thickness of Redox Potential Discontinuity Layer (a visual indication of black)

Presence (and %) of biological structures (e.g., chironomids, tubes, macrophytes), organic debris (e.g., twigs, leaves), shells

no debris, no odor, no sheen

Odor/Sheen Evaluation:

Observed (Y/N) N Color:____ Swirl Test:____ Odor:____ SudanIV (Y/N):____ UV Light (Y/N):____

Attempt 1

Time: 10:51	Photo Number:	Successful (circle one)
Penetration Depth (cm): 0 - 30	Water Depth: 40.3	Rejected
GPS Coordinates: N 45.56986, W 122.72204		
Comment:		

Attempt 2

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Attempt 3

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Surface Sediment Sample Datasheet

Project Information		
Project: HPH100D	Sampling Method:	Contractor: Ballard
Date: ~~3/3/16~~ 3/4/16	VanVeen grab Sampler	Sample Team: KK, AC
Sample Location		
Mill Area:	Description of Location and Channel Bottom:	
Subarea:		
Station:		
SIL **Sample Collection and Description**		
Sample ID: ~~[illegible]~~ - 00	Containers: 2 (8 oz glass jar)	Sample Time: 11:55

Sediment Type (e.g., silt, sand)
Texture (e.g., fine-grain, poorly sorted)
Stratification, if any
Color (Munsell color scale) brown to gray soft silt over soft to
Moisture slightly stiff clayey silt
Presence/location/thickness of Redox Potential Discontinuity Layer (a visual indication of black)

Presence (and %) of biological structures (e.g., chironomids, tubes, macrophytes), organic debris (e.g., twigs, leaves), shells
no debris; no sheen, no odor

Odor/Sheen Evaluation:
Observed (Y/N) N Color:____ Swirl Test:____ Odor:____ SudanIV (Y/N):____ UV Light (Y/N):____

Attempt 1

Time: 11:55	Photo Number:	Successful (circle one)
Penetration Depth (cm): 0 - 30	Water Depth: 41.1	Rejected
GPS Coordinates: N 45.56901, W 122.72202		
Comment:		

Attempt 2

Time:	Photo Number:	**Successful** (circle one)
Penetration Depth (cm):	Water Depth:	**Rejected**
GPS Coordinates:		
Comment:		

Attempt 3

Time:	Photo Number:	**Successful** (circle one)
Penetration Depth (cm):	Water Depth:	**Rejected**
GPS Coordinates:		
Comment:		

Surface Sediment Sample Datasheet

Project Information		
Project: HPH100D	Sampling Method:	Contractor: Ballard
Date: ~~3/3/16~~ 3/4/16	VanVeen grab sampler	Sample Team: KK, AC

Sample Location	
Mill Area:	Description of Location and Channel Bottom:
Subarea:	
Station:	

SIL

Sample Collection and Description		
Sample ID: ~~[illegible]~~ - 07	Containers: 2 (8 oz glass jar)	Sample Time: 10:40

Sediment Type (e.g., silt, sand)

Texture (e.g., fine-grain, poorly sorted)

Stratification, if any

Color (Munsell color scale) brown to gray soft silt over soft to stiff

Moisture clayey silt

Presence/location/thickness of Redox Potential Discontinuity Layer (a visual indication of black)

Presence (and %) of biological structures (e.g., chironomids, tubes, macrophytes), organic debris (e.g., twigs, leaves), shells

no debris, no odor, no sheen

Odor/Sheen Evaluation:

Observed (Y/N) N Color: ____ Swirl Test: ____ Odor: ____ SudanIV (Y/N): ____ UV Light (Y/N): ____

Attempt 1

Time: 10:40	Photo Number:	Successful (circle one)
Penetration Depth (cm): 0 - 30	Water Depth: 36.8	Rejected
GPS Coordinates: N 45.56955, ~~[illegible]~~ W 122.72041		
Comment:		

Attempt 2

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Attempt 3

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Surface Sediment Sample Datasheet

Project Information		
Project: HPH100D	Sampling Method:	Contractor: Ballard
Date: ~~3/3/10~~ 3/4/10	VanVeen grab Sampler	Sample Team: KK, AC

Sample Location	
Mill Area:	Description of Location and Channel Bottom:
Subarea:	
Station:	

Sample Collection and Description		
Sample ID: SIL ~~[illegible]~~ -08	Containers: 2 (8 oz glass jar)	Sample Time: 10:25

Sediment Type (e.g., silt, sand)

Texture (e.g., fine-grain, poorly sorted)

Stratification, if any

Color (Munsell color scale) brown to gray soft silt over soft to stiff

Moisture gray clayey silt

Presence/location/thickness of Redox Potential Discontinuity Layer (a visual indication of black)

Presence (and %) of biological structures (e.g., chironomids, tubes, macrophytes), organic debris (e.g., twigs, leaves), shells

Odor/Sheen Evaluation:

Observed (Y/N)_____ Color:_______ Swirl Test:_________ Odor:____________ SudanIV (Y/N):____ UV Light (Y/N):____

Attempt 1

Time: 10:25	Photo Number:	Successful (circle one)
Penetration Depth (cm): 0-30	Water Depth: 39.8	Rejected
GPS Coordinates: N 45.56884, W 122.72073		
Comment:		

Attempt 2

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Attempt 3

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Surface Sediment Sample Datasheet

Project Information		
Project: HPH100D,	Sampling Method:	Contractor: Ballard
Date: ~~3/3/16~~ 3/4/16	VanVeen grab sampler	Sample Team: KK, AC
Sample Location		
Mill Area:	Description of Location and Channel Bottom:	
Subarea:		
Station:		
Sample Collection and Description		
Sample ID: SIL ~~[illegible]~~ - 09	Containers: 2 (8 oz glass jar)	Sample Time: 10:21

Sediment Type (e.g., silt, sand)

Texture (e.g., fine-grain, poorly sorted)

Stratification, if any

Color (Munsell color scale) brown to gray soft silt over soft to stiff

Moisture gray clayey silt with sand

Presence/location/thickness of Redox Potential Discontinuity Layer (a visual indication of black)

Presence (and %) of biological structures (e.g., chironomids, tubes, macrophytes), organic debris (e.g., twigs, leaves), shells

no debris, no odor, no sheen

Odor/Sheen Evaluation:

Observed (Y/N) N Color:____ Swirl Test:____ Odor:____ SudanIV (Y/N):____ UV Light (Y/N):____

Attempt 1

Time: 10:21	Photo Number:	Successful (circle one)
Penetration Depth (cm): 0-30	Water Depth: 38.9	Rejected
GPS Coordinates: N 45.51815, W 122.72032		
Comment:		

Attempt 2

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Attempt 3

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Surface Sediment Sample Datasheet

Project Information		
Project: HPH100D	Sampling Method:	Contractor: Ballard
Date: ~~3/3/16~~ 3/4/16	VanVeen grab sampler	Sample Team: KK, AC

Sample Location	
Mill Area:	Description of Location and Channel Bottom:
Subarea:	
Station:	

Sample Collection and Description		
Sample ID: SIL-10	Containers: 2 (8 oz glass jar)	Sample Time: 10:11

Sediment Type (e.g., silt, sand)

Texture (e.g., fine-grain, poorly sorted)

Stratification, if any

Color (Munsell color scale) brown over gray soft silt over soft to stiff gray clayey silt

Moisture

Presence/location/thickness of Redox Potential Discontinuity Layer (a visual indication of black)

Presence (and %) of biological structures (e.g., chironomids, tubes, macrophytes), organic debris (e.g., twigs, leaves), shells

no debris, no odor, no sheen

Odor/Sheen Evaluation:

Observed (Y/N) N Color:____ Swirl Test:____ Odor:____ SudanIV (Y/N):____ UV Light (Y/N):____

Attempt 1

Time: 10:11	Photo Number:	Successful (circle one)
Penetration Depth (cm): 0-30	Water Depth: 39.2	Rejected
GPS Coordinates: N 45.56828, W 122.71880		
Comment:		

Attempt 2

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Attempt 3

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Surface Sediment Sample Datasheet

Project Information		
Project: HPH100D	Sampling Method:	Contractor: Ballard
Date: ~~3/3/10~~ 3/4/10	VanVeen grab sampler	Sample Team: KK, AC
Sample Location		
Mill Area:	Description of Location and Channel Bottom:	
Subarea:		
Station:		
Sample Collection and Description		
Sample ID: SIL - 11	Containers: 2 (8 oz glass jar)	Sample Time: 10:02

Sediment Type (e.g., silt, sand)
Texture (e.g., fine-grain, poorly sorted)
Stratification, if any
Color (Munsell color scale) brown to gray soft silt over gray clayey silt
Moisture
Presence/location/thickness of Redox Potential Discontinuity Layer (a visual indication of black)

Presence (and %) of biological structures (e.g., chironomids, tubes, macrophytes), organic debris (e.g., twigs, leaves), shells
no debris, no odor, no sheen

Odor/Sheen Evaluation:
Observed (Y/N) N Color:____ Swirl Test:____ Odor:____ SudanIV (Y/N):____ UV Light (Y/N):____

Attempt 1

Time: 10:02	Photo Number:	Successful (circle one)
Penetration Depth (cm): 0-30	Water Depth: 39.9	Rejected
GPS Coordinates: N 45.56758, W 122.71809		
Comment:		

Attempt 2

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Attempt 3

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Surface Sediment Sample Datasheet

Project Information		
Project: HPH100D	Sampling Method:	Contractor: Ballard
Date: ~~3/3/16~~ 3/4/16	VanVeen grab sampler	Sample Team: KK, AC

Sample Location	
Mill Area:	Description of Location and Channel Bottom:
Subarea:	
Station:	

Sample Collection and Description

Sample ID: SIL [illegible] -12	Containers: 2 (8 oz glass jar)	Sample Time: 9:54

Sediment Type (e.g., silt, sand)
Texture (e.g., fine-grain, poorly sorted)
Stratification, if any
Color (Munsell color scale) brown to gray soft silt over gray clayey silt
Moisture
Presence/location/thickness of Redox Potential Discontinuity Layer (a visual indication of black)

Presence (and %) of biological structures (e.g., chironomids, tubes, macrophytes), organic debris (e.g., twigs, leaves), shells
Some metal debris (possible paint chip), worm, no ~~[illegible]~~ odor, no sheen

Odor/Sheen Evaluation:
Observed (Y/N) N Color: ____ Swirl Test: ____ Odor: ____ SudanIV (Y/N): ____ UV Light (Y/N): ____

Attempt 1

Time: 9:54	Photo Number:	Successful (circle one)
Penetration Depth (cm): 0-30	Water Depth: 39.0	Rejected
GPS Coordinates: N 45.56057, W 122.71718		
Comment: offset due to barge		

Attempt 2

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Attempt 3

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Surface Sediment Sample Datasheet

Project Information		
Project: HPH100D	Sampling Method:	Contractor: Ballard
Date: ~~3/3/16~~ 3/4/16	VanVeen grab sampler	Sample Team: KK, AC

Sample Location	
Mill Area:	Description of Location and Channel Bottom:
Subarea:	
Station:	

Sample Collection and Description		
Sample ID: ~~[illegible]~~ SIL - 13	Containers: 2 (8 oz glass jar)	Sample Time: 9:45

Sediment Type (e.g., silt, sand)

Texture (e.g., fine-grain, poorly sorted)

Stratification, if any

Color (Munsell color scale) brown to gray soft silt over gray clayey silt

Moisture

Presence/location/thickness of Redox Potential Discontinuity Layer (a visual indication of black)

Presence (and %) of biological structures (e.g., chironomids, tubes, macrophytes), organic debris (e.g., twigs, leaves), shells

Odor/Sheen Evaluation:

Observed (Y/N)_____ Color:________ Swirl Test:_________ Odor:_____________ SudanIV (Y/N):_____ UV Light (Y/N):____

Attempt 1

Time: 9:45	Photo Number:	Successful (circle one)
Penetration Depth (cm): 0-30	Water Depth: 31.6	Rejected
GPS Coordinates: N 45.56690, W 122.71571		
Comment: duplicate sample ~~[illegible]~~ SIL-21, offset due to barge		

Attempt 2

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Attempt 3

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Surface Sediment Sample Datasheet

Project Information		
Project: HPH100D	Sampling Method:	Contractor: Ballard
Date: ~~3/3/16~~ 3/4/16	VanVeen grab sampler	Sample Team: KK, AC

Sample Location	
Mill Area:	Description of Location and Channel Bottom:
Subarea:	
Station:	

Sample Collection and Description		
SIL Sample ID: ~~[illegible]~~ -14	Containers: 2 (8 oz glass jar)	Sample Time: 9:36

Sediment Type (e.g., silt, sand)

Texture (e.g., fine-grain, poorly sorted)

Stratification, if any

Color (Munsell color scale) brown to gray soft silt over gray clayey silt

Moisture

Presence/location/thickness of Redox Potential Discontinuity Layer (a visual indication of black)

Presence (and %) of biological structures (e.g., chironomids, tubes, macrophytes), organic debris (e.g., twigs, leaves), shells

no debris, no odor, no sheen

Odor/Sheen Evaluation:

Observed (Y/N) N Color:____ Swirl Test:____ Odor:____ SudanIV (Y/N):____ UV Light (Y/N):____

Attempt 1

Time: 9:36	Photo Number:	Successful (circle one)
Penetration Depth (cm): 0 - 30	Water Depth: 35.3	Rejected
GPS Coordinates: N 45.56625, W 122.71453		
Comment:		

Attempt 2

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Attempt 3

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Surface Sediment Sample Datasheet

Project Information		
Project: HPH100D	Sampling Method:	Contractor: Ballard
Date: ~~3/3/16~~ 3/4/16	VanVeen grab Sampler	Sample Team: KK, AC

Sample Location	
Mill Area:	Description of Location and Channel Bottom:
Subarea:	
Station:	

Sample Collection and Description

Sample ID: SIL ~~[illegible]~~ -15	Containers: 2 (8 oz glass jar)	Sample Time: 9:25

Sediment Type (e.g., silt, sand)

Texture (e.g., fine-grain, poorly sorted)

Stratification, if any

Color (Munsell color scale) brown over gray Silty sand with rocks

Moisture

Presence/location/thickness of Redox Potential Discontinuity Layer (a visual indication of black)

Presence (and %) of biological structures (e.g., chironomids, tubes, macrophytes), organic debris (e.g., twigs, leaves), shells

no odor, no sheen, various size rocks, one corbicula

Odor/Sheen Evaluation:

Observed (Y/N) N Color:______ Swirl Test:______ Odor:______ SudanIV (Y/N):____ UV Light (Y/N):____

Attempt 1

Time: 9:19	Photo Number:	Successful (circle one)
Penetration Depth (cm): 0 - 30	Water Depth: 36.2	Rejected
GPS Coordinates: N 45.56571, W 122.71579		
Comment: Jaws filled with rocks + shells		

Attempt 2

Time: 9:25	Photo Number:	Successful (circle one)
Penetration Depth (cm): 0 - 30	Water Depth: 36.2	Rejected
GPS Coordinates: N 45.56572, W 122.71590		
Comment:		

Attempt 3

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Surface Sediment Sample Datasheet

Project Information		
Project: HPH100D	Sampling Method:	Contractor: Ballard
Date: ~~3/3/16~~ 3/4/16	VanVeen grab Sampler	Sample Team: KK, AC
Sample Location		
Mill Area:	Description of Location and Channel Bottom:	
Subarea:		
Station:		
Sample Collection and Description		
Sample ID: SL [redacted] - 110	Containers: 2 (8 oz glass jar)	Sample Time: 9:05

Sediment Type (e.g., silt, sand)
Texture (e.g., fine-grain, poorly sorted)
Stratification, if any
Color (Munsell color scale) brown to gray soft silt over gray clayey silt
Moisture
Presence/location/thickness of Redox Potential Discontinuity Layer (a visual indication of black)

Presence (and %) of biological structures (e.g., chironomids, tubes, macrophytes), organic debris (e.g., twigs, leaves), shells
no debris, no odor, no sheen

Odor/Sheen Evaluation:
Observed (Y/N) N Color:____ Swirl Test:____ Odor:____ SudanIV (Y/N):____ UV Light (Y/N):____

Attempt 1

Time: 9:05	Photo Number:	Successful (circle one)
Penetration Depth (cm): 0 - 30	Water Depth: 30.0	Rejected
GPS Coordinates: N 45.[redacted]56429, W 122.71262		
Comment: offset due to barge, ~ 100 ft. south		

Attempt 2

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Attempt 3

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Surface Sediment Sample Datasheet

Project Information		
Project: HPH100D	Sampling Method:	Contractor: Ballard
Date: ~~3/3/16~~ 3/4/16	VanVeen grab sampler	Sample Team: KK, AC

Sample Location	
Mill Area:	Description of Location and Channel Bottom:
Subarea:	
Station:	

Sample Collection and Description		
Sample ID: SIL ~~[illegible]~~ - 17	Containers: 2 (8 oz glass jar)	Sample Time: 8:54

Sediment Type (e.g., silt, sand)

Texture (e.g., fine-grain, poorly sorted)

Stratification, if any

Color (Munsell color scale) brown to gray soft silt over gray

Moisture clayey silt

Presence/location/thickness of Redox Potential Discontinuity Layer (a visual indication of black)

Presence (and %) of biological structures (e.g., chironomids, tubes, macrophytes), organic debris (e.g., twigs, leaves), shells

no debris, no odor, no sheen

Odor/Sheen Evaluation:

Observed (Y/N) N Color: ____ Swirl Test: ____ Odor: ____ SudanIV (Y/N): ____ UV Light (Y/N): ____

Attempt 1

Time: 8:54	Photo Number:	Successful (circle one)
Penetration Depth (cm): 0 - 30	Water Depth: 28.8	Rejected
GPS Coordinates: N 45.56387, W 122.71051		
Comment: duplicate sample SIL ~~[illegible]~~ -20		

Attempt 2

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Attempt 3

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Surface Sediment Sample Datasheet

Project Information		
Project: HPH1OOD	Sampling Method:	Contractor: Ballard
Date: ~~3/3/16~~ 3/4/16	VanVeen grab Sampler	Sample Team: KK, AC

Sample Location	
Mill Area:	Description of Location and Channel Bottom:
Subarea:	
Station:	

Sample Collection and Description

Sample ID: ~~[illegible]~~ SIL-18	Containers: 2 (8 oz glass jar)	Sample Time: 8:15

Sediment Type (e.g., silt, sand) soft silt

Texture (e.g., fine-grain, poorly sorted)

Stratification, if any

Color (Munsell color scale) brown to gray soft silt over gray clayey silt

Moisture

Presence/location/thickness of Redox Potential Discontinuity Layer (a visual indication of black)

Presence (and %) of biological structures (e.g., chironomids, tubes, macrophytes), organic debris (e.g., twigs, leaves), shells

NO debris, no odor, no sheen.

Odor/Sheen Evaluation:

Observed (Y/N) N Color:____ Swirl Test:____ Odor:____ SudanIV (Y/N):____ UV Light (Y/N):____

Attempt 1

Time: 8:15	Photo Number:	Successful (circle one)
Penetration Depth (cm): 0-30	Water Depth: 19.9	Rejected
GPS Coordinates: N 45.56208, W 122.70866		
Comment:		

Attempt 2

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Attempt 3

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Surface Sediment Sample Datasheet

Project Information		
Project: HPH100D	Sampling Method:	Contractor: Ballard
Date: ~~3/3/10~~ 3/4/10	VanVeen grab Sampler	Sample Team: KK, AC
Sample Location		
Mill Area:	Description of Location and Channel Bottom:	
Subarea:		
Station:		
Sample Collection and Description		
Sample ID: ~~[illegible]~~ SIL – 19	Containers: 2 (8 oz glass jar)	Sample Time: 8:36

Sediment Type (e.g., silt, sand)
Texture (e.g., fine-grain, poorly sorted)
Stratification, if any
Color (Munsell color scale) brown, soft silt over gray clayey silt
Moisture
Presence/location/thickness of Redox Potential Discontinuity Layer (a visual indication of black)

Presence (and %) of biological structures (e.g., chironomids, tubes, macrophytes), organic debris (e.g., twigs, leaves), shells
no debris, no odor, no sheen

Odor/Sheen Evaluation:
Observed (Y/N) N Color:____ Swirl Test:____ Odor:____ SudanIV (Y/N):____ UV Light (Y/N):____

Attempt 1

Time: 8:36	Photo Number:	Successful (circle one)
Penetration Depth (cm): 0-30	Water Depth: 22.8	Rejected
GPS Coordinates: N 45.56284, W 122.70868		
Comment:		

Attempt 2

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

Attempt 3

Time:	Photo Number:	Successful (circle one)
Penetration Depth (cm):	Water Depth:	Rejected
GPS Coordinates:		
Comment:		

APPENDIX D

Laboratory Analytical Report

Apex Labs

AMENDED REPORT

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

Friday, August 12, 2016

Keith Kroeger
GeoSyntec
621 SW Morrison St, Suite 600
Portland, OR 97204

RE: Portland Harbor Sediment / HPH100D

Enclosed are the results of analyses for work order A6C0180, which was received by the laboratory on 3/4/2016 at 1:00:00PM.

Thank you for using Apex Labs. We appreciate your business and strive to provide the highest quality services to the environmental industry.

If you have any questions concerning this report or the services we offer, please feel free to contact me by email at: ldomenighini@apex-labs.com, or by phone at 503-718-2323.

Apex Labs

AMENDED REPORT

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

ANALYTICAL REPORT FOR SAMPLES

SAMPLE INFORMATION

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
SIL-00	A6C0180-01	Sediment	03/04/16 11:35	03/04/16 13:00
SIL-01	A6C0180-02	Sediment	03/04/16 11:48	03/04/16 13:00
SIL-02	A6C0180-03	Sediment	03/04/16 11:20	03/04/16 13:00
SIL-03	A6C0180-04	Sediment	03/04/16 11:14	03/04/16 13:00
SIL-04	A6C0180-05	Sediment	03/04/16 11:03	03/04/16 13:00
SIL-05	A6C0180-06	Sediment	03/04/16 10:51	03/04/16 13:00
SIL-06	A6C0180-07	Sediment	03/04/16 11:55	03/04/16 13:00
SIL-07	A6C0180-08	Sediment	03/04/16 10:40	03/04/16 13:00
SIL-08	A6C0180-09	Sediment	03/04/16 10:25	03/04/16 13:00
SIL-09	A6C0180-10	Sediment	03/04/16 10:21	03/04/16 13:00
SIL-10	A6C0180-11	Sediment	03/04/16 10:11	03/04/16 13:00
SIL-11	A6C0180-12	Sediment	03/04/16 10:02	03/04/16 13:00
SIL-12	A6C0180-13	Sediment	03/04/16 09:54	03/04/16 13:00
SIL-13	A6C0180-14	Sediment	03/04/16 09:45	03/04/16 13:00
SIL-14	A6C0180-15	Sediment	03/04/16 09:36	03/04/16 13:00
SIL-15	A6C0180-16	Sediment	03/04/16 09:25	03/04/16 13:00
SIL-16	A6C0180-17	Sediment	03/04/16 09:05	03/04/16 13:00
SIL-17	A6C0180-18	Sediment	03/04/16 08:54	03/04/16 13:00
SIL-18	A6C0180-19	Sediment	03/04/16 08:15	03/04/16 13:00
SIL-19	A6C0180-20	Sediment	03/04/16 08:36	03/04/16 13:00
SIL-20	A6C0180-21	Sediment	03/04/16 00:00	03/04/16 13:00
SIL-21	A6C0180-22	Sediment	03/04/16 00:00	03/04/16 13:00
SIL-00-RSM	A6C0180-23	Sediment	03/04/16 11:35	03/04/16 13:00
SIL-01-RSM	A6C0180-24	Sediment	03/04/16 11:48	03/04/16 13:00
SIL-02-RSM	A6C0180-25	Sediment	03/04/16 11:20	03/04/16 13:00
SIL-03-RSM	A6C0180-26	Sediment	03/04/16 11:14	03/04/16 13:00
SIL-04-RSM	A6C0180-27	Sediment	03/04/16 11:03	03/04/16 13:00
SIL-05-RSM	A6C0180-28	Sediment	03/04/16 10:51	03/04/16 13:00
SIL-06-RSM	A6C0180-29	Sediment	03/04/16 11:55	03/04/16 13:00
SIL-07-RSM	A6C0180-30	Sediment	03/04/16 10:40	03/04/16 13:00
SIL-08-RSM	A6C0180-31	Sediment	03/04/16 10:25	03/04/16 13:00
SIL-09-RSM	A6C0180-32	Sediment	03/04/16 10:21	03/04/16 13:00
SIL-10-RSM	A6C0180-33	Sediment	03/04/16 10:11	03/04/16 13:00
SIL-11-RSM	A6C0180-34	Sediment	03/04/16 10:02	03/04/16 13:00
SIL-12-RSM	A6C0180-35	Sediment	03/04/16 09:54	03/04/16 13:00

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The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Lisa A Domenighini

Lisa Domenighini, Client Services Manager

12232 S.W. Garden Place
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GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

ANALYTICAL REPORT FOR SAMPLES

SAMPLE INFORMATION

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
SIL-13-RSM	A6C0180-36	Sediment	03/04/16 09:45	03/04/16 13:00
SIL-14-RSM	A6C0180-37	Sediment	03/04/16 09:36	03/04/16 13:00
SIL-15-RSM	A6C0180-38	Sediment	03/04/16 09:25	03/04/16 13:00
SIL-16-RSM	A6C0180-39	Sediment	03/04/16 09:05	03/04/16 13:00
SIL-17-RSM	A6C0180-40	Sediment	03/04/16 08:54	03/04/16 13:00
SIL-18-RSM	A6C0180-41	Sediment	03/04/16 08:15	03/04/16 13:00
SIL-19-RSM	A6C0180-42	Sediment	03/04/16 08:36	03/04/16 13:00
SIL-20-RSM	A6C0180-43	Sediment	03/04/16 00:00	03/04/16 13:00
SIL-21-RSM	A6C0180-44	Sediment	03/04/16 00:00	03/04/16 13:00

Apex Labs

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AMENDED REPORT

GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

ANALYTICAL SAMPLE RESULTS

Polychlorinated Biphenyls -- EPA 8082A

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
SIL-00-RSM (A6C0180-23RE1)			**Matrix: Sediment**		**Batch: 6030897**			**C-07**
Aroclor 1016	ND	7.73	15.4	ug/kg dry	10	03/29/16 18:27	EPA 8082A	
Aroclor 1221	ND	7.73	15.4	"	"	"	"	
Aroclor 1232	ND	7.73	15.4	"	"	"	"	
Aroclor 1242	ND	7.73	15.4	"	"	"	"	
Aroclor 1248	ND	7.73	15.4	"	"	"	"	
Aroclor 1254	**784**	7.73	15.4	"	"	"	"	P-10
Aroclor 1260	**180**	7.73	15.4	"	"	"	"	P-10
Aroclor 1262	ND	7.73	15.4	"	"	"	"	
Aroclor 1268	ND	7.73	15.4	"	"	"	"	
Surrogate: Decachlorobiphenyl (Surr)			*Recovery: 86 %*	*Limits: 44-120 %*	"	"	"	
SIL-01-RSM (A6C0180-24RE1)			**Matrix: Sediment**		**Batch: 6030897**			**C-07**
Aroclor 1016	ND	7.20	14.3	ug/kg dry	10	03/29/16 19:24	EPA 8082A	
Aroclor 1221	ND	7.20	14.3	"	"	"	"	
Aroclor 1232	ND	7.20	14.3	"	"	"	"	
Aroclor 1242	ND	7.20	14.3	"	"	"	"	
Aroclor 1248	ND	7.20	14.3	"	"	"	"	
Aroclor 1254	**841**	7.20	14.3	"	"	"	"	P-10
Aroclor 1260	**155**	7.20	14.3	"	"	"	"	P-10
Aroclor 1262	ND	7.20	14.3	"	"	"	"	
Aroclor 1268	ND	7.20	14.3	"	"	"	"	
Surrogate: Decachlorobiphenyl (Surr)			*Recovery: 82 %*	*Limits: 44-120 %*	"	"	"	
SIL-02-RSM (A6C0180-25RE1)			**Matrix: Sediment**		**Batch: 6030897**			**C-07**
Aroclor 1016	ND	3.48	6.90	ug/kg dry	5	03/29/16 20:21	EPA 8082A	
Aroclor 1221	ND	3.48	6.90	"	"	"	"	
Aroclor 1232	ND	3.48	6.90	"	"	"	"	
Aroclor 1242	ND	3.48	6.90	"	"	"	"	
Aroclor 1248	ND	3.48	6.90	"	"	"	"	
Aroclor 1254	**192**	3.48	6.90	"	"	"	"	P-10
Aroclor 1260	**98.4**	3.48	6.90	"	"	"	"	P-10
Aroclor 1262	ND	3.48	6.90	"	"	"	"	
Aroclor 1268	ND	3.48	6.90	"	"	"	"	
Surrogate: Decachlorobiphenyl (Surr)			*Recovery: 76 %*	*Limits: 44-120 %*	"	"	"	
SIL-03-RSM (A6C0180-26RE1)			**Matrix: Sediment**		**Batch: 6030897**			**C-07**
Aroclor 1016	ND	3.39	6.72	ug/kg dry	5	03/29/16 21:18	EPA 8082A	

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GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

ANALYTICAL SAMPLE RESULTS

Polychlorinated Biphenyls -- EPA 8082A

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
SIL-03-RSM (A6C0180-26RE1)			**Matrix: Sediment**		**Batch: 6030897**			**C-07**
Aroclor 1221	ND	3.39	6.72	ug/kg dry	5	"	EPA 8082A	
Aroclor 1232	ND	3.39	6.72	"	"	"	"	
Aroclor 1242	ND	3.39	6.72	"	"	"	"	
Aroclor 1248	ND	3.39	6.72	"	"	"	"	
Aroclor 1254	**89.8**	3.39	6.72	"	"	"	"	P-10
Aroclor 1260	**39.3**	3.39	6.72	"	"	"	"	P-10
Aroclor 1262	ND	3.39	6.72	"	"	"	"	
Aroclor 1268	ND	3.39	6.72	"	"	"	"	
Surrogate: Decachlorobiphenyl (Surr)			*Recovery: 74 %*	*Limits: 44-120 %*	"	"	"	
SIL-04-RSM (A6C0180-27RE2)			**Matrix: Sediment**		**Batch: 6030897**			**C-07**
Aroclor 1016	ND	0.667	1.32	ug/kg dry	1	03/30/16 16:54	EPA 8082A	
Aroclor 1221	ND	0.667	1.32	"	"	"	"	
Aroclor 1232	ND	0.667	1.32	"	"	"	"	
Aroclor 1242	ND	0.667	1.32	"	"	"	"	
Aroclor 1248	ND	0.667	1.32	"	"	"	"	
Aroclor 1254	**24.7**	0.667	1.32	"	"	"	"	P-10
Aroclor 1260	**8.91**	0.667	1.32	"	"	"	"	P-10
Aroclor 1262	ND	0.667	1.32	"	"	"	"	
Aroclor 1268	ND	0.667	1.32	"	"	"	"	
Surrogate: Decachlorobiphenyl (Surr)			*Recovery: 79 %*	*Limits: 44-120 %*	"	"	"	
SIL-05-RSM (A6C0180-28RE2)			**Matrix: Sediment**		**Batch: 6030897**			**C-07**
Aroclor 1016	ND	0.695	1.38	ug/kg dry	1	03/30/16 17:49	EPA 8082A	
Aroclor 1221	ND	0.695	1.38	"	"	"	"	
Aroclor 1232	ND	0.695	1.38	"	"	"	"	
Aroclor 1242	ND	0.695	1.38	"	"	"	"	
Aroclor 1248	ND	0.695	1.38	"	"	"	"	
Aroclor 1254	**25.9**	0.695	1.38	"	"	"	"	P-10
Aroclor 1260	**22.4**	0.695	1.38	"	"	"	"	P-10
Aroclor 1262	ND	0.695	1.38	"	"	"	"	
Aroclor 1268	ND	0.695	1.38	"	"	"	"	
Surrogate: Decachlorobiphenyl (Surr)			*Recovery: 63 %*	*Limits: 44-120 %*	"	"	"	
SIL-06-RSM (A6C0180-29RE2)			**Matrix: Sediment**		**Batch: 6030897**			**C-07**
Aroclor 1016	ND	0.724	1.44	ug/kg dry	1	03/30/16 18:44	EPA 8082A	
Aroclor 1221	ND	0.724	1.44	"	"	"	"	

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AMENDED REPORT

GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

ANALYTICAL SAMPLE RESULTS

Polychlorinated Biphenyls -- EPA 8082A

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
SIL-06-RSM (A6C0180-29RE2)			**Matrix: Sediment**		**Batch: 6030897**			**C-07**
Aroclor 1232	ND	0.724	1.44	ug/kg dry	1	"	EPA 8082A	
Aroclor 1242	ND	0.724	1.44	"	"	"	"	
Aroclor 1248	ND	0.724	1.44	"	"	"	"	
Aroclor 1254	**29.2**	0.724	1.44	"	"	"	"	P-10
Aroclor 1260	**22.7**	0.724	1.44	"	"	"	"	P-10
Aroclor 1262	ND	0.724	1.44	"	"	"	"	
Aroclor 1268	ND	0.724	1.44	"	"	"	"	
Surrogate: Decachlorobiphenyl (Surr)			*Recovery: 77 %*	*Limits: 44-120 %*	"	"	"	
SIL-07-RSM (A6C0180-30RE2)			**Matrix: Sediment**		**Batch: 6030897**			**C-07**
Aroclor 1016	ND	0.698	1.38	ug/kg dry	1	03/30/16 19:40	EPA 8082A	
Aroclor 1221	ND	0.698	1.38	"	"	"	"	
Aroclor 1232	ND	0.698	1.38	"	"	"	"	
Aroclor 1242	ND	0.698	1.38	"	"	"	"	
Aroclor 1248	ND	0.698	1.38	"	"	"	"	
Aroclor 1254	**49.5**	0.698	1.38	"	"	"	"	P-10
Aroclor 1260	**31.6**	0.698	1.38	"	"	"	"	P-10
Aroclor 1262	ND	0.698	1.38	"	"	"	"	
Aroclor 1268	ND	0.698	1.38	"	"	"	"	
Surrogate: Decachlorobiphenyl (Surr)			*Recovery: 58 %*	*Limits: 44-120 %*	"	"	"	
SIL-08-RSM (A6C0180-31RE2)			**Matrix: Sediment**		**Batch: 6030897**			**C-07**
Aroclor 1016	ND	1.40	2.78	ug/kg dry	2	03/30/16 16:54	EPA 8082A	
Aroclor 1221	ND	1.40	2.78	"	"	"	"	
Aroclor 1232	ND	1.40	2.78	"	"	"	"	
Aroclor 1242	ND	1.40	2.78	"	"	"	"	
Aroclor 1248	ND	1.40	2.78	"	"	"	"	
Aroclor 1254	**93.0**	1.40	2.78	"	"	"	"	P-10
Aroclor 1260	**62.7**	1.40	2.78	"	"	"	"	P-10
Aroclor 1262	ND	1.40	2.78	"	"	"	"	
Aroclor 1268	ND	1.40	2.78	"	"	"	"	
Surrogate: Decachlorobiphenyl (Surr)			*Recovery: 91 %*	*Limits: 44-120 %*	"	"	"	
SIL-09-RSM (A6C0180-32RE2)			**Matrix: Sediment**		**Batch: 6030897**			**C-07**
Aroclor 1016	ND	0.703	1.40	ug/kg dry	1	03/30/16 17:49	EPA 8082A	
Aroclor 1221	ND	0.703	1.40	"	"	"	"	
Aroclor 1232	ND	0.703	1.40	"	"	"	"	

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GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

ANALYTICAL SAMPLE RESULTS

Polychlorinated Biphenyls -- EPA 8082A

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
SIL-09-RSM (A6C0180-32RE2)			**Matrix: Sediment**		**Batch: 6030897**			**C-07**
Aroclor 1242	ND	0.703	1.40	ug/kg dry	1	"	EPA 8082A	
Aroclor 1248	ND	0.703	1.40	"	"	"	"	
Aroclor 1254	**58.7**	0.703	1.40	"	"	"	"	P-10
Aroclor 1260	**44.7**	0.703	1.40	"	"	"	"	P-10
Aroclor 1262	ND	0.703	1.40	"	"	"	"	
Aroclor 1268	ND	0.703	1.40	"	"	"	"	
Surrogate: Decachlorobiphenyl (Surr)		*Recovery: 76 %*		*Limits: 44-120 %*	"	"	"	
SIL-10-RSM (A6C0180-33RE2)			**Matrix: Sediment**		**Batch: 6030915**			**C-07**
Aroclor 1016	ND	3.48	6.91	ug/kg dry	5	03/30/16 18:44	EPA 8082A	
Aroclor 1221	ND	3.48	6.91	"	"	"	"	
Aroclor 1232	ND	3.48	6.91	"	"	"	"	
Aroclor 1242	ND	3.48	6.91	"	"	"	"	
Aroclor 1248	ND	3.48	6.91	"	"	"	"	
Aroclor 1254	**190**	3.48	6.91	"	"	"	"	P-10
Aroclor 1260	**111**	3.48	6.91	"	"	"	"	P-10
Aroclor 1262	ND	3.48	6.91	"	"	"	"	
Aroclor 1268	ND	3.48	6.91	"	"	"	"	
Surrogate: Decachlorobiphenyl (Surr)		*Recovery: 72 %*		*Limits: 44-120 %*	"	"	"	
SIL-11-RSM (A6C0180-34RE2)			**Matrix: Sediment**		**Batch: 6030915**			**C-07**
Aroclor 1016	ND	2.13	4.22	ug/kg dry	2	03/30/16 19:40	EPA 8082A	
Aroclor 1221	ND	2.13	4.22	"	"	"	"	
Aroclor 1232	ND	2.13	4.22	"	"	"	"	
Aroclor 1242	ND	2.13	4.22	"	"	"	"	
Aroclor 1248	ND	2.13	4.22	"	"	"	"	
Aroclor 1254	**65.9**	2.13	4.22	"	"	"	"	P-10
Aroclor 1260	**165**	2.13	4.22	"	"	"	"	P-10
Aroclor 1262	ND	2.13	4.22	"	"	"	"	
Aroclor 1268	ND	2.13	4.22	"	"	"	"	
Surrogate: Decachlorobiphenyl (Surr)		*Recovery: 95 %*		*Limits: 44-120 %*	"	"	"	
SIL-12-RSM (A6C0180-35RE1)			**Matrix: Sediment**		**Batch: 6030915**			**C-07**
Aroclor 1016	ND	6.92	13.7	ug/kg dry	10	03/29/16 20:21	EPA 8082A	
Aroclor 1221	ND	6.92	13.7	"	"	"	"	
Aroclor 1232	ND	6.92	13.7	"	"	"	"	
Aroclor 1242	ND	6.92	13.7	"	"	"	"	

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GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

ANALYTICAL SAMPLE RESULTS

Polychlorinated Biphenyls -- EPA 8082A

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
SIL-12-RSM (A6C0180-35RE1)			**Matrix: Sediment**		**Batch: 6030915**			**C-07**
Aroclor 1248	ND	6.92	13.7	ug/kg dry	10	"	EPA 8082A	
Aroclor 1254	**193**	6.92	13.7	"	"	"	"	P-10
Aroclor 1260	**230**	6.92	13.7	"	"	"	"	P-10
Aroclor 1262	ND	6.92	13.7	"	"	"	"	
Aroclor 1268	ND	6.92	13.7	"	"	"	"	
Surrogate: Decachlorobiphenyl (Surr)		*Recovery: 70 %*		*Limits: 44-120 %*	"	"	"	
SIL-13-RSM (A6C0180-36RE1)			**Matrix: Sediment**		**Batch: 6030915**			**C-07**
Aroclor 1016	ND	0.691	1.37	ug/kg dry	1	03/29/16 21:17	EPA 8082A	
Aroclor 1221	ND	0.691	1.37	"	"	"	"	
Aroclor 1232	ND	0.691	1.37	"	"	"	"	
Aroclor 1242	ND	0.691	1.37	"	"	"	"	
Aroclor 1248	ND	0.691	1.37	"	"	"	"	
Aroclor 1254	**59.8**	0.691	1.37	"	"	"	"	P-10
Aroclor 1260	**85.5**	0.691	1.37	"	"	"	"	P-10
Aroclor 1262	ND	0.691	1.37	"	"	"	"	
Aroclor 1268	ND	0.691	1.37	"	"	"	"	
Surrogate: Decachlorobiphenyl (Surr)		*Recovery: 55 %*		*Limits: 44-120 %*	"	"	"	
SIL-14-RSM (A6C0180-37RE1)			**Matrix: Sediment**		**Batch: 6030915**			**C-07**
Aroclor 1016	ND	0.711	1.41	ug/kg dry	1	03/29/16 17:35	EPA 8082A	
Aroclor 1221	ND	0.711	1.41	"	"	"	"	
Aroclor 1232	ND	0.711	1.41	"	"	"	"	
Aroclor 1242	ND	0.711	1.41	"	"	"	"	
Aroclor 1248	ND	0.711	1.41	"	"	"	"	
Aroclor 1254	**25.7**	0.711	1.41	"	"	"	"	P-10
Aroclor 1260	**46.6**	0.711	1.41	"	"	"	"	P-10
Aroclor 1262	ND	0.711	1.41	"	"	"	"	
Aroclor 1268	ND	0.711	1.41	"	"	"	"	
Surrogate: Decachlorobiphenyl (Surr)		*Recovery: 46 %*		*Limits: 44-120 %*	"	"	"	
SIL-15-RSM (A6C0180-38RE1)			**Matrix: Sediment**		**Batch: 6030915**			**C-07**
Aroclor 1016	ND	0.590	1.17	ug/kg dry	1	03/29/16 18:30	EPA 8082A	
Aroclor 1221	ND	0.590	1.17	"	"	"	"	
Aroclor 1232	ND	0.590	1.17	"	"	"	"	
Aroclor 1242	ND	0.590	1.17	"	"	"	"	
Aroclor 1248	ND	0.590	1.17	"	"	"	"	

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AMENDED REPORT

12232 S.W. Garden Place
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GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

ANALYTICAL SAMPLE RESULTS

Polychlorinated Biphenyls -- EPA 8082A

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
SIL-15-RSM (A6C0180-38RE1)			**Matrix: Sediment**		**Batch: 6030915**			**C-07**
Aroclor 1254	**33.6**	0.590	1.17	ug/kg dry	1	"	EPA 8082A	P-10
Aroclor 1260	**32.8**	0.590	1.17	"	"	"	"	P-10
Aroclor 1262	ND	0.590	1.17	"	"	"	"	
Aroclor 1268	ND	0.590	1.17	"	"	"	"	
Surrogate: Decachlorobiphenyl (Surr)		*Recovery: 99 %*		*Limits: 44-120 %*	"	"	"	
SIL-16-RSM (A6C0180-39RE1)			**Matrix: Sediment**		**Batch: 6030915**			**C-07**
Aroclor 1016	ND	0.690	1.37	ug/kg dry	1	03/29/16 19:26	EPA 8082A	
Aroclor 1221	ND	0.690	1.37	"	"	"	"	
Aroclor 1232	ND	0.690	1.37	"	"	"	"	
Aroclor 1242	ND	0.690	1.37	"	"	"	"	
Aroclor 1248	ND	0.690	1.37	"	"	"	"	
Aroclor 1254	**25.7**	0.690	1.37	"	"	"	"	P-10
Aroclor 1260	**44.1**	0.690	1.37	"	"	"	"	P-10
Aroclor 1262	ND	0.690	1.37	"	"	"	"	
Aroclor 1268	ND	0.690	1.37	"	"	"	"	
Surrogate: Decachlorobiphenyl (Surr)		*Recovery: 61 %*		*Limits: 44-120 %*	"	"	"	
SIL-17-RSM (A6C0180-40RE1)			**Matrix: Sediment**		**Batch: 6030915**			**C-07**
Aroclor 1016	ND	0.722	1.43	ug/kg dry	1	03/29/16 20:21	EPA 8082A	
Aroclor 1221	ND	0.722	1.43	"	"	"	"	
Aroclor 1232	ND	0.722	1.43	"	"	"	"	
Aroclor 1242	ND	0.722	1.43	"	"	"	"	
Aroclor 1248	ND	0.722	1.43	"	"	"	"	
Aroclor 1254	**22.7**	0.722	1.43	"	"	"	"	P-10
Aroclor 1260	**39.5**	0.722	1.43	"	"	"	"	P-10
Aroclor 1262	ND	0.722	1.43	"	"	"	"	
Aroclor 1268	ND	0.722	1.43	"	"	"	"	
Surrogate: Decachlorobiphenyl (Surr)		*Recovery: 72 %*		*Limits: 44-120 %*	"	"	"	
SIL-18-RSM (A6C0180-41RE1)			**Matrix: Sediment**		**Batch: 6030915**			**C-07**
Aroclor 1016	ND	0.702	1.39	ug/kg dry	1	03/29/16 21:17	EPA 8082A	
Aroclor 1221	ND	0.702	1.39	"	"	"	"	
Aroclor 1232	ND	0.702	1.39	"	"	"	"	
Aroclor 1242	ND	0.702	1.39	"	"	"	"	
Aroclor 1248	ND	0.702	1.39	"	"	"	"	
Aroclor 1254	**25.8**	0.702	1.39	"	"	"	"	P-10

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AMENDED REPORT

GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

ANALYTICAL SAMPLE RESULTS

Polychlorinated Biphenyls -- EPA 8082A

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
SIL-18-RSM (A6C0180-41RE1)			**Matrix: Sediment**		**Batch: 6030915**			**C-07**
Aroclor 1260	**38.3**	0.702	1.39	ug/kg dry	1	"	EPA 8082A	P-10
Aroclor 1262	ND	0.702	1.39	"	"	"	"	
Aroclor 1268	ND	0.702	1.39	"	"	"	"	
Surrogate: Decachlorobiphenyl (Surr)			*Recovery: 66 %*	*Limits: 44-120 %*	"	"	"	
SIL-19-RSM (A6C0180-42RE1)			**Matrix: Sediment**		**Batch: 6030915**			**C-07**
Aroclor 1016	ND	1.02	2.03	ug/kg dry	1	03/29/16 22:11	EPA 8082A	
Aroclor 1221	ND	1.02	2.03	"	"	"	"	
Aroclor 1232	ND	1.02	2.03	"	"	"	"	
Aroclor 1242	ND	1.02	2.03	"	"	"	"	
Aroclor 1248	ND	1.02	2.03	"	"	"	"	
Aroclor 1254	**18.0**	1.02	2.03	"	"	"	"	P-10
Aroclor 1260	**33.2**	1.02	2.03	"	"	"	"	P-10
Aroclor 1262	ND	1.02	2.03	"	"	"	"	
Aroclor 1268	ND	1.02	2.03	"	"	"	"	
Surrogate: Decachlorobiphenyl (Surr)			*Recovery: 63 %*	*Limits: 44-120 %*	"	"	"	
SIL-20-RSM (A6C0180-43)			**Matrix: Sediment**		**Batch: 6030837**			**C-07**
Aroclor 1016	ND	0.695	1.38	ug/kg dry	1	03/28/16 17:11	EPA 8082A	
Aroclor 1221	ND	0.695	1.38	"	"	"	"	
Aroclor 1232	ND	0.695	1.38	"	"	"	"	
Aroclor 1242	ND	0.695	1.38	"	"	"	"	
Aroclor 1248	ND	0.695	1.38	"	"	"	"	
Aroclor 1254	**27.8**	0.695	1.38	"	"	"	"	P-10
Aroclor 1260	**38.1**	0.695	1.38	"	"	"	"	P-10
Aroclor 1262	ND	0.695	1.38	"	"	"	"	
Aroclor 1268	ND	0.695	1.38	"	"	"	"	
Surrogate: Decachlorobiphenyl (Surr)			*Recovery: 68 %*	*Limits: 44-120 %*	"	"	"	
SIL-21-RSM (A6C0180-44RE1)			**Matrix: Sediment**		**Batch: 6030837**			**C-07**
Aroclor 1016	ND	3.43	6.80	ug/kg dry	5	03/29/16 12:20	EPA 8082A	
Aroclor 1221	ND	3.43	6.80	"	"	"	"	
Aroclor 1232	ND	3.43	6.80	"	"	"	"	
Aroclor 1242	ND	3.43	6.80	"	"	"	"	
Aroclor 1248	ND	3.43	6.80	"	"	"	"	
Aroclor 1254	**61.2**	3.43	6.80	"	"	"	"	P-10
Aroclor 1260	**131**	3.43	6.80	"	"	"	"	P-10

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Lisa A Domenighini

Lisa Domenighini, Client Services Manager

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AMENDED REPORT

12232 S.W. Garden Place
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GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

ANALYTICAL SAMPLE RESULTS

Polychlorinated Biphenyls -- EPA 8082A

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
SIL-21-RSM (A6C0180-44RE1)			**Matrix: Sediment**		**Batch: 6030837**			**C-07**
Aroclor 1262	ND	3.43	6.80	ug/kg dry	5	"	EPA 8082A	
Aroclor 1268	ND	3.43	6.80	"	"	"	"	
Surrogate: Decachlorobiphenyl (Surr)			*Recovery: 67 %*	*Limits: 44-120 %*	"	"	"	

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Lisa A Domenighini

Lisa Domenighini, Client Services Manager

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AMENDED REPORT

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GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

ANALYTICAL SAMPLE RESULTS

Conventional Chemistry Parameters

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
SIL-00 (A6C0180-01)			**Matrix: Sediment**					
Batch: 6030253								
Total Organic Carbon	**18000**	---	200	mg/kg	1	03/17/16 17:20	SM 5310B MOD	
SIL-01 (A6C0180-02)			**Matrix: Sediment**					
Batch: 6030253								
Total Organic Carbon	**19000**	---	200	mg/kg	1	03/17/16 17:20	SM 5310B MOD	
SIL-02 (A6C0180-03)			**Matrix: Sediment**					
Batch: 6030253								
Total Organic Carbon	**19000**	---	200	mg/kg	1	03/17/16 17:20	SM 5310B MOD	
SIL-03 (A6C0180-04)			**Matrix: Sediment**					
Batch: 6030253								
Total Organic Carbon	**15000**	---	200	mg/kg	1	03/17/16 17:20	SM 5310B MOD	
SIL-04 (A6C0180-05)			**Matrix: Sediment**					
Batch: 6030253								
Total Organic Carbon	**7700**	---	200	mg/kg	1	03/17/16 17:20	SM 5310B MOD	
SIL-05 (A6C0180-06)			**Matrix: Sediment**					
Batch: 6030253								
Total Organic Carbon	**20000**	---	200	mg/kg	1	03/17/16 17:20	SM 5310B MOD	
SIL-06 (A6C0180-07)			**Matrix: Sediment**					
Batch: 6030253								
Total Organic Carbon	**20000**	---	200	mg/kg	1	03/17/16 17:20	SM 5310B MOD	
SIL-07 (A6C0180-08)			**Matrix: Sediment**					
Batch: 6030253								
Total Organic Carbon	**17000**	---	200	mg/kg	1	03/17/16 17:20	SM 5310B MOD	
SIL-08 (A6C0180-09)			**Matrix: Sediment**					
Batch: 6030253								
Total Organic Carbon	**19000**	---	200	mg/kg	1	03/17/16 17:20	SM 5310B MOD	
SIL-09 (A6C0180-10)			**Matrix: Sediment**					
Batch: 6030253								
Total Organic Carbon	**22000**	---	200	mg/kg	1	03/17/16 17:20	SM 5310B MOD	
SIL-10 (A6C0180-11)			**Matrix: Sediment**					
Batch: 6030253								
Total Organic Carbon	**19000**	---	200	mg/kg	1	03/17/16 17:20	SM 5310B MOD	
SIL-11 (A6C0180-12)			**Matrix: Sediment**					

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AMENDED REPORT

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GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

ANALYTICAL SAMPLE RESULTS

Conventional Chemistry Parameters

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
SIL-11 (A6C0180-12)			**Matrix: Sediment**					
Batch: 6030253								
Total Organic Carbon	**22000**	---	200	mg/kg	1	03/17/16 17:20	SM 5310B MOD	
SIL-12 (A6C0180-13)			**Matrix: Sediment**					
Batch: 6030253								
Total Organic Carbon	**20000**	---	200	mg/kg	1	03/17/16 17:20	SM 5310B MOD	
SIL-13 (A6C0180-14)			**Matrix: Sediment**					
Batch: 6030253								
Total Organic Carbon	**21000**	---	200	mg/kg	1	03/17/16 17:20	SM 5310B MOD	
SIL-14 (A6C0180-15)			**Matrix: Sediment**					
Batch: 6030253								
Total Organic Carbon	**21000**	---	200	mg/kg	1	03/17/16 17:20	SM 5310B MOD	
SIL-15 (A6C0180-16)			**Matrix: Sediment**					
Batch: 6030253								
Total Organic Carbon	**7500**	---	200	mg/kg	1	03/17/16 17:20	SM 5310B MOD	
SIL-16 (A6C0180-17)			**Matrix: Sediment**					
Batch: 6030253								
Total Organic Carbon	**7500**	---	200	mg/kg	1	03/17/16 17:20	SM 5310B MOD	
SIL-17 (A6C0180-18)			**Matrix: Sediment**					
Batch: 6030253								
Total Organic Carbon	**20000**	---	200	mg/kg	1	03/17/16 17:20	SM 5310B MOD	
SIL-18 (A6C0180-19)			**Matrix: Sediment**					
Batch: 6030253								
Total Organic Carbon	**22000**	---	200	mg/kg	1	03/17/16 17:20	SM 5310B MOD	
SIL-19 (A6C0180-20)			**Matrix: Sediment**					
Batch: 6030253								
Total Organic Carbon	**21000**	---	200	mg/kg	1	03/17/16 17:20	SM 5310B MOD	

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GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

ANALYTICAL SAMPLE RESULTS

Grain Size by ASTM D 422m/PSET Parameters

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
SIL-00 (A6C0180-01)			**Matrix: Sediment**		**Batch: 6030284**			
Gravel (>2.00mm)	**0.12**	---		% of Total	1	03/17/16 16:20	ASTM D 422m	GS-01
Percent Retained 4.75 mm sieve (#4)	**0.06**	---		"	"	"	"	GS-01
Percent Retained 2.00 mm sieve (#10)	**0.06**	---		"	"	"	"	GS-01
Sand (0.063mm - 2.00mm)	**12.4**	---		"	"	"	"	GS-01
Percent Retained 0.85 mm sieve (#20)	**0.58**	---		"	"	"	"	GS-01
Percent Retained 0.425 mm sieve (#40)	**0.89**	---		"	"	"	"	GS-01
Percent Retained 0.250 mm sieve (#60)	**1.29**	---		"	"	"	"	GS-01
Percent Retained 0.150 mm sieve (#100)	**2.52**	---		"	"	"	"	GS-01
Percent Retained 0.106 mm sieve (#140)	**2.37**	---		"	"	"	"	GS-01
Percent Retained 0.075 mm sieve (#200)	**3.30**	---		"	"	"	"	GS-01
Percent Retained 0.063 mm sieve (#230)	**1.49**	---		"	"	"	"	GS-01
Silt (0.005mm < 0.063mm)	**68.2**	---		"	"	"	"	GS-01
Clay (< 0.005 mm)	**19.2**	---		"	"	"	"	GS-01
SIL-01 (A6C0180-02)			**Matrix: Sediment**		**Batch: 6030284**			
Gravel (>2.00mm)	**0.41**	---		% of Total	1	03/17/16 16:20	ASTM D 422m	GS-01
Percent Retained 4.75 mm sieve (#4)	0.00	---		"	"	"	"	GS-01
Percent Retained 2.00 mm sieve (#10)	**0.41**	---		"	"	"	"	GS-01
Sand (0.063mm - 2.00mm)	**18.9**	---		"	"	"	"	GS-01
Percent Retained 0.85 mm sieve (#20)	**4.25**	---		"	"	"	"	GS-01
Percent Retained 0.425 mm sieve (#40)	**5.30**	---		"	"	"	"	GS-01
Percent Retained 0.250 mm sieve (#60)	**3.43**	---		"	"	"	"	GS-01
Percent Retained 0.150 mm sieve (#100)	**2.71**	---		"	"	"	"	GS-01
Percent Retained 0.106 mm sieve (#140)	**1.42**	---		"	"	"	"	GS-01

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AMENDED REPORT

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GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

ANALYTICAL SAMPLE RESULTS

Grain Size by ASTM D 422m/PSET Parameters

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
SIL-01 (A6C0180-02)			**Matrix: Sediment**		**Batch: 6030284**			
Percent Retained 0.075 mm sieve (#200)	**1.34**	---		% of Total	1	"	ASTM D 422m	GS-01
Percent Retained 0.063 mm sieve (#230)	**0.49**	---		"	"	"	"	GS-01
Silt (0.005mm < 0.063mm)	**54.9**	---		"	"	"	"	GS-01
Clay (< 0.005 mm)	**25.7**	---		"	"	"	"	GS-01
SIL-02 (A6C0180-03)			**Matrix: Sediment**		**Batch: 6030284**			
Gravel (>2.00mm)	**0.12**	---		% of Total	1	03/17/16 16:20	ASTM D 422m	GS-01
Percent Retained 4.75 mm sieve (#4)	0.00	---		"	"	"	"	GS-01
Percent Retained 2.00 mm sieve (#10)	**0.12**	---		"	"	"	"	GS-01
Sand (0.063mm - 2.00mm)	**17.1**	---		"	"	"	"	GS-01
Percent Retained 0.85 mm sieve (#20)	**0.12**	---		"	"	"	"	GS-01
Percent Retained 0.425 mm sieve (#40)	**0.33**	---		"	"	"	"	GS-01
Percent Retained 0.250 mm sieve (#60)	**1.51**	---		"	"	"	"	GS-01
Percent Retained 0.150 mm sieve (#100)	**4.23**	---		"	"	"	"	GS-01
Percent Retained 0.106 mm sieve (#140)	**3.50**	---		"	"	"	"	GS-01
Percent Retained 0.075 mm sieve (#200)	**5.02**	---		"	"	"	"	GS-01
Percent Retained 0.063 mm sieve (#230)	**2.37**	---		"	"	"	"	GS-01
Silt (0.005mm < 0.063mm)	**64.0**	---		"	"	"	"	GS-01
Clay (< 0.005 mm)	**18.8**	---		"	"	"	"	GS-01
SIL-03 (A6C0180-04)			**Matrix: Sediment**		**Batch: 6030284**			
Gravel (>2.00mm)	**0.63**	---		% of Total	1	03/17/16 16:20	ASTM D 422m	GS-01
Percent Retained 4.75 mm sieve (#4)	**0.12**	---		"	"	"	"	GS-01
Percent Retained 2.00 mm sieve (#10)	**0.50**	---		"	"	"	"	GS-01
Sand (0.063mm - 2.00mm)	**51.6**	---		"	"	"	"	GS-01
Percent Retained 0.85 mm sieve (#20)	**1.17**	---		"	"	"	"	GS-01

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AMENDED REPORT

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GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

ANALYTICAL SAMPLE RESULTS

Grain Size by ASTM D 422m/PSET Parameters

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
SIL-03 (A6C0180-04)			**Matrix: Sediment**		**Batch: 6030284**			
Percent Retained 0.425 mm sieve (#40)	**5.42**	---		% of Total	1	"	ASTM D 422m	GS-01
Percent Retained 0.250 mm sieve (#60)	**14.5**	---		"	"	"	"	GS-01
Percent Retained 0.150 mm sieve (#100)	**15.8**	---		"	"	"	"	GS-01
Percent Retained 0.106 mm sieve (#140)	**6.80**	---		"	"	"	"	GS-01
Percent Retained 0.075 mm sieve (#200)	**6.09**	---		"	"	"	"	GS-01
Percent Retained 0.063 mm sieve (#230)	**1.76**	---		"	"	"	"	GS-01
Silt (0.005mm < 0.063mm)	**33.9**	---		"	"	"	"	GS-01
Clay (< 0.005 mm)	**13.9**	---		"	"	"	"	GS-01
SIL-04 (A6C0180-05)			**Matrix: Sediment**		**Batch: 6030284**			
Gravel (>2.00mm)	**1.02**	---		% of Total	1	03/17/16 16:20	ASTM D 422m	GS-01
Percent Retained 4.75 mm sieve (#4)	**0.46**	---		"	"	"	"	GS-01
Percent Retained 2.00 mm sieve (#10)	**0.56**	---		"	"	"	"	GS-01
Sand (0.063mm - 2.00mm)	**89.0**	---		"	"	"	"	GS-01
Percent Retained 0.85 mm sieve (#20)	**0.91**	---		"	"	"	"	GS-01
Percent Retained 0.425 mm sieve (#40)	**16.3**	---		"	"	"	"	GS-01
Percent Retained 0.250 mm sieve (#60)	**36.9**	---		"	"	"	"	GS-01
Percent Retained 0.150 mm sieve (#100)	**26.7**	---		"	"	"	"	GS-01
Percent Retained 0.106 mm sieve (#140)	**5.15**	---		"	"	"	"	GS-01
Percent Retained 0.075 mm sieve (#200)	**2.42**	---		"	"	"	"	GS-01
Percent Retained 0.063 mm sieve (#230)	**0.66**	---		"	"	"	"	GS-01
Silt (0.005mm < 0.063mm)	**7.00**	---		"	"	"	"	GS-01
Clay (< 0.005 mm)	**3.00**	---		"	"	"	"	GS-01
SIL-05 (A6C0180-06)			**Matrix: Sediment**		**Batch: 6030284**			
Gravel (>2.00mm)	**0.15**	---		% of Total	1	03/17/16 16:20	ASTM D 422m	GS-01

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Lisa A Domenighini

Lisa Domenighini, Client Services Manager

Apex Labs

AMENDED REPORT

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

ANALYTICAL SAMPLE RESULTS

Grain Size by ASTM D 422m/PSET Parameters

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
SIL-05 (A6C0180-06)			**Matrix: Sediment**		**Batch: 6030284**			
Percent Retained 4.75 mm sieve (#4)	**0.15**	---		% of Total	1	"	ASTM D 422m	GS-01
Percent Retained 2.00 mm sieve (#10)	0.00	---		"	"	"	"	GS-01
Sand (0.063mm - 2.00mm)	**8.48**	---		"	"	"	"	GS-01
Percent Retained 0.85 mm sieve (#20)	**1.90**	---		"	"	"	"	GS-01
Percent Retained 0.425 mm sieve (#40)	**1.73**	---		"	"	"	"	GS-01
Percent Retained 0.250 mm sieve (#60)	**0.55**	---		"	"	"	"	GS-01
Percent Retained 0.150 mm sieve (#100)	**1.18**	---		"	"	"	"	GS-01
Percent Retained 0.106 mm sieve (#140)	**1.13**	---		"	"	"	"	GS-01
Percent Retained 0.075 mm sieve (#200)	**1.38**	---		"	"	"	"	GS-01
Percent Retained 0.063 mm sieve (#230)	**0.62**	---		"	"	"	"	GS-01
Silt (0.005mm < 0.063mm)	**60.5**	---		"	"	"	"	GS-01
Clay (< 0.005 mm)	**30.9**	---		"	"	"	"	GS-01
SIL-06 (A6C0180-07)			**Matrix: Sediment**		**Batch: 6030284**			
Gravel (>2.00mm)	**0.09**	---		% of Total	1	03/17/16 16:20	ASTM D 422m	GS-01
Percent Retained 4.75 mm sieve (#4)	**0.09**	---		"	"	"	"	GS-01
Percent Retained 2.00 mm sieve (#10)	0.00	---		"	"	"	"	GS-01
Sand (0.063mm - 2.00mm)	**5.80**	---		"	"	"	"	GS-01
Percent Retained 0.85 mm sieve (#20)	**1.19**	---		"	"	"	"	GS-01
Percent Retained 0.425 mm sieve (#40)	**1.07**	---		"	"	"	"	GS-01
Percent Retained 0.250 mm sieve (#60)	**0.52**	---		"	"	"	"	GS-01
Percent Retained 0.150 mm sieve (#100)	**0.88**	---		"	"	"	"	GS-01
Percent Retained 0.106 mm sieve (#140)	**0.77**	---		"	"	"	"	GS-01
Percent Retained 0.075 mm sieve (#200)	**0.95**	---		"	"	"	"	GS-01

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AMENDED REPORT

12232 S.W. Garden Place
Tigard, OR 97223
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503-718-0333 Fax

GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

ANALYTICAL SAMPLE RESULTS

Grain Size by ASTM D 422m/PSET Parameters

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
SIL-06 (A6C0180-07)			**Matrix: Sediment**		**Batch: 6030284**			
Percent Retained 0.063 mm sieve (#230)	**0.43**	---		% of Total	1	"	ASTM D 422m	GS-01
Silt (0.005mm < 0.063mm)	**65.5**	---		"	"	"	"	GS-01
Clay (< 0.005 mm)	**28.6**	---		"	"	"	"	GS-01
SIL-07 (A6C0180-08)			**Matrix: Sediment**		**Batch: 6030284**			
Gravel (>2.00mm)	0.00	---		% of Total	1	03/17/16 16:20	ASTM D 422m	GS-01
Percent Retained 4.75 mm sieve (#4)	0.00	---		"	"	"	"	GS-01
Percent Retained 2.00 mm sieve (#10)	0.00	---		"	"	"	"	GS-01
Sand (0.063mm - 2.00mm)	**12.7**	---		"	"	"	"	GS-01
Percent Retained 0.85 mm sieve (#20)	**2.67**	---		"	"	"	"	GS-01
Percent Retained 0.425 mm sieve (#40)	**1.78**	---		"	"	"	"	GS-01
Percent Retained 0.250 mm sieve (#60)	**1.29**	---		"	"	"	"	GS-01
Percent Retained 0.150 mm sieve (#100)	**2.81**	---		"	"	"	"	GS-01
Percent Retained 0.106 mm sieve (#140)	**1.85**	---		"	"	"	"	GS-01
Percent Retained 0.075 mm sieve (#200)	**1.74**	---		"	"	"	"	GS-01
Percent Retained 0.063 mm sieve (#230)	**0.60**	---		"	"	"	"	GS-01
Silt (0.005mm < 0.063mm)	**55.2**	---		"	"	"	"	GS-01
Clay (< 0.005 mm)	**32.1**	---		"	"	"	"	GS-01
SIL-08 (A6C0180-09)			**Matrix: Sediment**		**Batch: 6030284**			
Gravel (>2.00mm)	**0.05**	---		% of Total	1	03/17/16 16:20	ASTM D 422m	GS-01
Percent Retained 4.75 mm sieve (#4)	**0.01**	---		"	"	"	"	GS-01
Percent Retained 2.00 mm sieve (#10)	**0.04**	---		"	"	"	"	GS-01
Sand (0.063mm - 2.00mm)	**11.6**	---		"	"	"	"	GS-01
Percent Retained 0.85 mm sieve (#20)	**1.96**	---		"	"	"	"	GS-01
Percent Retained 0.425 mm sieve (#40)	**1.76**	---		"	"	"	"	GS-01

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Lisa A Domenighini

Lisa Domenighini, Client Services Manager

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AMENDED REPORT

12232 S.W. Garden Place
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GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

ANALYTICAL SAMPLE RESULTS

Grain Size by ASTM D 422m/PSET Parameters

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
SIL-08 (A6C0180-09)			**Matrix: Sediment**		**Batch: 6030284**			
Percent Retained 0.250 mm sieve (#60)	**1.69**	---		% of Total	1	"	ASTM D 422m	GS-01
Percent Retained 0.150 mm sieve (#100)	**2.45**	---		"	"	"	"	GS-01
Percent Retained 0.106 mm sieve (#140)	**1.52**	---		"	"	"	"	GS-01
Percent Retained 0.075 mm sieve (#200)	**1.62**	---		"	"	"	"	GS-01
Percent Retained 0.063 mm sieve (#230)	**0.63**	---		"	"	"	"	GS-01
Silt (0.005mm < 0.063mm)	**57.8**	---		"	"	"	"	GS-01
Clay (< 0.005 mm)	**30.5**	---		"	"	"	"	GS-01
SIL-09 (A6C0180-10)			**Matrix: Sediment**		**Batch: 6030284**			
Gravel (>2.00mm)	**0.28**	---		% of Total	1	03/17/16 16:20	ASTM D 422m	GS-01
Percent Retained 4.75 mm sieve (#4)	**0.02**	---		"	"	"	"	GS-01
Percent Retained 2.00 mm sieve (#10)	**0.25**	---		"	"	"	"	GS-01
Sand (0.063mm - 2.00mm)	**16.8**	---		"	"	"	"	GS-01
Percent Retained 0.85 mm sieve (#20)	**2.80**	---		"	"	"	"	GS-01
Percent Retained 0.425 mm sieve (#40)	**4.33**	---		"	"	"	"	GS-01
Percent Retained 0.250 mm sieve (#60)	**3.65**	---		"	"	"	"	GS-01
Percent Retained 0.150 mm sieve (#100)	**3.57**	---		"	"	"	"	GS-01
Percent Retained 0.106 mm sieve (#140)	**1.05**	---		"	"	"	"	GS-01
Percent Retained 0.075 mm sieve (#200)	**0.99**	---		"	"	"	"	GS-01
Percent Retained 0.063 mm sieve (#230)	**0.37**	---		"	"	"	"	GS-01
Silt (0.005mm < 0.063mm)	**55.2**	---		"	"	"	"	GS-01
Clay (< 0.005 mm)	**27.8**	---		"	"	"	"	GS-01
SIL-10 (A6C0180-11)			**Matrix: Sediment**		**Batch: 6030469**			
Gravel (>2.00mm)	**0.29**	---		% of Total	1	03/17/16 21:27	ASTM D 422m	GS-01
Percent Retained 4.75 mm sieve (#4)	**0.29**	---		"	"	"	"	GS-01

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AMENDED REPORT

12232 S.W. Garden Place
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GeoSyntec	Project: Portland Harbor Sediment	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

ANALYTICAL SAMPLE RESULTS

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
SIL-10 (A6C0180-11)			**Matrix: Sediment**		**Batch: 6030469**			
Percent Retained 2.00 mm sieve (#10)	0.00	---		% of Total	1	"	ASTM D 422m	GS-01
Sand (0.063mm - 2.00mm)	**15.8**	---		"	"	"	"	GS-01
Percent Retained 0.85 mm sieve (#20)	**2.63**	---		"	"	"	"	GS-01
Percent Retained 0.425 mm sieve (#40)	**2.42**	---		"	"	"	"	GS-01
Percent Retained 0.250 mm sieve (#60)	**3.48**	---		"	"	"	"	GS-01
Percent Retained 0.150 mm sieve (#100)	**3.44**	---		"	"	"	"	GS-01
Percent Retained 0.106 mm sieve (#140)	**1.53**	---		"	"	"	"	GS-01
Percent Retained 0.075 mm sieve (#200)	**1.65**	---		"	"	"	"	GS-01
Percent Retained 0.063 mm sieve (#230)	**0.67**	---		"	"	"	"	GS-01
Silt (0.005mm < 0.063mm)	**55.0**	---		"	"	"	"	GS-01
Clay (< 0.005 mm)	**28.9**	---		"	"	"	"	GS-01
SIL-11 (A6C0180-12)			**Matrix: Sediment**		**Batch: 6030469**			
Gravel (>2.00mm)	**0.01**	---		% of Total	1	03/17/16 21:27	ASTM D 422m	GS-01
Percent Retained 4.75 mm sieve (#4)	0.00	---		"	"	"	"	GS-01
Percent Retained 2.00 mm sieve (#10)	**0.01**	---		"	"	"	"	GS-01
Sand (0.063mm - 2.00mm)	**9.08**	---		"	"	"	"	GS-01
Percent Retained 0.85 mm sieve (#20)	**0.59**	---		"	"	"	"	GS-01
Percent Retained 0.425 mm sieve (#40)	**1.26**	---		"	"	"	"	GS-01
Percent Retained 0.250 mm sieve (#60)	**1.29**	---		"	"	"	"	GS-01
Percent Retained 0.150 mm sieve (#100)	**2.13**	---		"	"	"	"	GS-01
Percent Retained 0.106 mm sieve (#140)	**1.35**	---		"	"	"	"	GS-01
Percent Retained 0.075 mm sieve (#200)	**1.72**	---		"	"	"	"	GS-01
Percent Retained 0.063 mm sieve (#230)	**0.75**	---		"	"	"	"	GS-01

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Lisa A Domenighini

Lisa Domenighini, Client Services Manager

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AMENDED REPORT

12232 S.W. Garden Place
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GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

ANALYTICAL SAMPLE RESULTS

Grain Size by ASTM D 422m/PSET Parameters

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
SIL-11 (A6C0180-12)			**Matrix: Sediment**		**Batch: 6030469**			
Silt (0.005mm < 0.063mm)	**62.6**	---		% of Total	1	"	ASTM D 422m	GS-01
Clay (< 0.005 mm)	**28.4**	---		"	"	"	"	GS-01
SIL-12 (A6C0180-13)			**Matrix: Sediment**		**Batch: 6030469**			
Gravel (>2.00mm)	**1.01**	---		% of Total	1	03/17/16 21:27	ASTM D 422m	GS-01
Percent Retained 4.75 mm sieve (#4)	**0.52**	---		"	"	"	"	GS-01
Percent Retained 2.00 mm sieve (#10)	**0.49**	---		"	"	"	"	GS-01
Sand (0.063mm - 2.00mm)	**16.8**	---		"	"	"	"	GS-01
Percent Retained 0.85 mm sieve (#20)	**3.10**	---		"	"	"	"	GS-01
Percent Retained 0.425 mm sieve (#40)	**3.69**	---		"	"	"	"	GS-01
Percent Retained 0.250 mm sieve (#60)	**3.50**	---		"	"	"	"	GS-01
Percent Retained 0.150 mm sieve (#100)	**3.12**	---		"	"	"	"	GS-01
Percent Retained 0.106 mm sieve (#140)	**1.42**	---		"	"	"	"	GS-01
Percent Retained 0.075 mm sieve (#200)	**1.44**	---		"	"	"	"	GS-01
Percent Retained 0.063 mm sieve (#230)	**0.57**	---		"	"	"	"	GS-01
Silt (0.005mm < 0.063mm)	**56.3**	---		"	"	"	"	GS-01
Clay (< 0.005 mm)	**25.9**	---		"	"	"	"	GS-01
SIL-13 (A6C0180-14)			**Matrix: Sediment**		**Batch: 6030469**			
Gravel (>2.00mm)	**0.37**	---		% of Total	1	03/17/16 21:27	ASTM D 422m	GS-01
Percent Retained 4.75 mm sieve (#4)	**0.20**	---		"	"	"	"	GS-01
Percent Retained 2.00 mm sieve (#10)	**0.17**	---		"	"	"	"	GS-01
Sand (0.063mm - 2.00mm)	**18.9**	---		"	"	"	"	GS-01
Percent Retained 0.85 mm sieve (#20)	**1.36**	---		"	"	"	"	GS-01
Percent Retained 0.425 mm sieve (#40)	**2.70**	---		"	"	"	"	GS-01
Percent Retained 0.250 mm sieve (#60)	**4.22**	---		"	"	"	"	GS-01

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AMENDED REPORT

12232 S.W. Garden Place
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GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

ANALYTICAL SAMPLE RESULTS

Grain Size by ASTM D 422m/PSET Parameters

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
SIL-13 (A6C0180-14)			**Matrix: Sediment**		**Batch: 6030469**			
Percent Retained 0.150 mm sieve (#100)	**4.37**	---		% of Total	1	"	ASTM D 422m	GS-01
Percent Retained 0.106 mm sieve (#140)	**2.21**	---		"	"	"	"	GS-01
Percent Retained 0.075 mm sieve (#200)	**2.85**	---		"	"	"	"	GS-01
Percent Retained 0.063 mm sieve (#230)	**1.18**	---		"	"	"	"	GS-01
Silt (0.005mm < 0.063mm)	**55.4**	---		"	"	"	"	GS-01
Clay (< 0.005 mm)	**25.3**	---		"	"	"	"	GS-01
SIL-14 (A6C0180-15)			**Matrix: Sediment**		**Batch: 6030469**			
Gravel (>2.00mm)	0.00	---		% of Total	1	03/17/16 21:27	ASTM D 422m	GS-01
Percent Retained 4.75 mm sieve (#4)	0.00	---		"	"	"	"	GS-01
Percent Retained 2.00 mm sieve (#10)	0.00	---		"	"	"	"	GS-01
Sand (0.063mm - 2.00mm)	**12.4**	---		"	"	"	"	GS-01
Percent Retained 0.85 mm sieve (#20)	**1.52**	---		"	"	"	"	GS-01
Percent Retained 0.425 mm sieve (#40)	**2.53**	---		"	"	"	"	GS-01
Percent Retained 0.250 mm sieve (#60)	**1.36**	---		"	"	"	"	GS-01
Percent Retained 0.150 mm sieve (#100)	**1.71**	---		"	"	"	"	GS-01
Percent Retained 0.106 mm sieve (#140)	**1.55**	---		"	"	"	"	GS-01
Percent Retained 0.075 mm sieve (#200)	**2.55**	---		"	"	"	"	GS-01
Percent Retained 0.063 mm sieve (#230)	**1.14**	---		"	"	"	"	GS-01
Silt (0.005mm < 0.063mm)	**61.2**	---		"	"	"	"	GS-01
Clay (< 0.005 mm)	**26.4**	---		"	"	"	"	GS-01
SIL-15 (A6C0180-16)			**Matrix: Sediment**		**Batch: 6030469**			
Gravel (>2.00mm)	**14.3**	---		% of Total	1	03/17/16 21:27	ASTM D 422m	GS-01
Percent Retained 4.75 mm sieve (#4)	**8.47**	---		"	"	"	"	GS-01
Percent Retained 2.00 mm sieve (#10)	**5.83**	---		"	"	"	"	GS-01

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Lisa A Domenighini

Lisa Domenighini, Client Services Manager

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AMENDED REPORT

12232 S.W. Garden Place
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GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

ANALYTICAL SAMPLE RESULTS

Grain Size by ASTM D 422m/PSET Parameters

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
SIL-15 (A6C0180-16)			**Matrix: Sediment**		**Batch: 6030469**			
Sand (0.063mm - 2.00mm)	**82.7**	---		% of Total	1	"	ASTM D 422m	GS-01
Percent Retained 0.85 mm sieve (#20)	**5.95**	---		"	"	"	"	GS-01
Percent Retained 0.425 mm sieve (#40)	**33.3**	---		"	"	"	"	GS-01
Percent Retained 0.250 mm sieve (#60)	**33.6**	---		"	"	"	"	GS-01
Percent Retained 0.150 mm sieve (#100)	**8.48**	---		"	"	"	"	GS-01
Percent Retained 0.106 mm sieve (#140)	**0.96**	---		"	"	"	"	GS-01
Percent Retained 0.075 mm sieve (#200)	**0.32**	---		"	"	"	"	GS-01
Percent Retained 0.063 mm sieve (#230)	**0.06**	---		"	"	"	"	GS-01
Silt (0.005mm < 0.063mm)	**2.20**	---		"	"	"	"	GS-01
Clay (< 0.005 mm)	**0.90**	---		"	"	"	"	GS-01
SIL-16 (A6C0180-17)			**Matrix: Sediment**		**Batch: 6030469**			
Gravel (>2.00mm)	0.00	---		% of Total	1	03/17/16 21:27	ASTM D 422m	GS-01
Percent Retained 4.75 mm sieve (#4)	0.00	---		"	"	"	"	GS-01
Percent Retained 2.00 mm sieve (#10)	0.00	---		"	"	"	"	GS-01
Sand (0.063mm - 2.00mm)	**8.35**	---		"	"	"	"	GS-01
Percent Retained 0.85 mm sieve (#20)	**1.42**	---		"	"	"	"	GS-01
Percent Retained 0.425 mm sieve (#40)	**1.79**	---		"	"	"	"	GS-01
Percent Retained 0.250 mm sieve (#60)	**1.76**	---		"	"	"	"	GS-01
Percent Retained 0.150 mm sieve (#100)	**1.18**	---		"	"	"	"	GS-01
Percent Retained 0.106 mm sieve (#140)	**0.71**	---		"	"	"	"	GS-01
Percent Retained 0.075 mm sieve (#200)	**1.02**	---		"	"	"	"	GS-01
Percent Retained 0.063 mm sieve (#230)	**0.48**	---		"	"	"	"	GS-01
Silt (0.005mm < 0.063mm)	**57.8**	---		"	"	"	"	GS-01

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AMENDED REPORT

GeoSyntec 621 SW Morrison St, Suite 600 Portland, OR 97204	Project: Portland Harbor Sediment Project Number: HPH100D Project Manager: Keith Kroeger	Reported: 08/12/16 11:59

ANALYTICAL SAMPLE RESULTS

Grain Size by ASTM D 422m/PSET Parameters

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
SIL-16 (A6C0180-17)			**Matrix: Sediment**		**Batch: 6030469**			
Clay (< 0.005 mm)	**33.8**	---		% of Total	1	"	ASTM D 422m	GS-01
SIL-17 (A6C0180-18)			**Matrix: Sediment**		**Batch: 6030469**			
Gravel (>2.00mm)	0.00	---		% of Total	1	03/17/16 21:27	ASTM D 422m	GS-01
Percent Retained 4.75 mm sieve (#4)	0.00	---		"	"	"	"	GS-01
Percent Retained 2.00 mm sieve (#10)	0.00	---		"	"	"	"	GS-01
Sand (0.063mm - 2.00mm)	**9.44**	---		"	"	"	"	GS-01
Percent Retained 0.85 mm sieve (#20)	**0.84**	---		"	"	"	"	GS-01
Percent Retained 0.425 mm sieve (#40)	**1.02**	---		"	"	"	"	GS-01
Percent Retained 0.250 mm sieve (#60)	**0.93**	---		"	"	"	"	GS-01
Percent Retained 0.150 mm sieve (#100)	**1.97**	---		"	"	"	"	GS-01
Percent Retained 0.106 mm sieve (#140)	**1.77**	---		"	"	"	"	GS-01
Percent Retained 0.075 mm sieve (#200)	**2.09**	---		"	"	"	"	GS-01
Percent Retained 0.063 mm sieve (#230)	**0.81**	---		"	"	"	"	GS-01
Silt (0.005mm < 0.063mm)	**54.4**	---		"	"	"	"	GS-01
Clay (< 0.005 mm)	**36.2**	---		"	"	"	"	GS-01
SIL-18 (A6C0180-19)			**Matrix: Sediment**		**Batch: 6030469**			
Gravel (>2.00mm)	**0.04**	---		% of Total	1	03/17/16 21:27	ASTM D 422m	GS-01
Percent Retained 4.75 mm sieve (#4)	0.00	---		"	"	"	"	GS-01
Percent Retained 2.00 mm sieve (#10)	**0.04**	---		"	"	"	"	GS-01
Sand (0.063mm - 2.00mm)	**6.16**	---		"	"	"	"	GS-01
Percent Retained 0.85 mm sieve (#20)	**0.11**	---		"	"	"	"	GS-01
Percent Retained 0.425 mm sieve (#40)	**1.25**	---		"	"	"	"	GS-01
Percent Retained 0.250 mm sieve (#60)	**1.08**	---		"	"	"	"	GS-01
Percent Retained 0.150 mm sieve (#100)	**0.90**	---		"	"	"	"	GS-01

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GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

ANALYTICAL SAMPLE RESULTS

Grain Size by ASTM D 422m/PSET Parameters

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
SIL-18 (A6C0180-19)			**Matrix: Sediment**		**Batch: 6030469**			
Percent Retained 0.106 mm sieve (#140)	**0.74**	---		% of Total	1	"	ASTM D 422m	GS-01
Percent Retained 0.075 mm sieve (#200)	**1.31**	---		"	"	"	"	GS-01
Percent Retained 0.063 mm sieve (#230)	**0.77**	---		"	"	"	"	GS-01
Silt (0.005mm < 0.063mm)	**67.3**	---		"	"	"	"	GS-01
Clay (< 0.005 mm)	**26.5**	---		"	"	"	"	GS-01
SIL-19 (A6C0180-20)			**Matrix: Sediment**		**Batch: 6030469**			
Gravel (>2.00mm)	**0.06**	---		% of Total	1	03/17/16 21:27	ASTM D 422m	GS-01
Percent Retained 4.75 mm sieve (#4)	0.00	---		"	"	"	"	GS-01
Percent Retained 2.00 mm sieve (#10)	**0.06**	---		"	"	"	"	GS-01
Sand (0.063mm - 2.00mm)	**9.13**	---		"	"	"	"	GS-01
Percent Retained 0.85 mm sieve (#20)	**1.43**	---		"	"	"	"	GS-01
Percent Retained 0.425 mm sieve (#40)	**1.95**	---		"	"	"	"	GS-01
Percent Retained 0.250 mm sieve (#60)	**1.35**	---		"	"	"	"	GS-01
Percent Retained 0.150 mm sieve (#100)	**1.05**	---		"	"	"	"	GS-01
Percent Retained 0.106 mm sieve (#140)	**0.96**	---		"	"	"	"	GS-01
Percent Retained 0.075 mm sieve (#200)	**1.57**	---		"	"	"	"	GS-01
Percent Retained 0.063 mm sieve (#230)	**0.81**	---		"	"	"	"	GS-01
Silt (0.005mm < 0.063mm)	**57.1**	---		"	"	"	"	GS-01
Clay (< 0.005 mm)	**33.7**	---		"	"	"	"	GS-01

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AMENDED REPORT

GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

ANALYTICAL SAMPLE RESULTS

Percent Dry Weight

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
SIL-00 (A6C0180-01)			**Matrix: Sediment**		**Batch: 6030213**			
% Solids	**42.5**	---	1.00	% by Weight	1	03/09/16 09:12	EPA 8000C	
SIL-01 (A6C0180-02)			**Matrix: Sediment**		**Batch: 6030213**			
% Solids	**38.5**	---	1.00	% by Weight	1	03/09/16 09:12	EPA 8000C	
SIL-02 (A6C0180-03)			**Matrix: Sediment**		**Batch: 6030213**			
% Solids	**48.6**	---	1.00	% by Weight	1	03/09/16 09:12	EPA 8000C	
SIL-03 (A6C0180-04)			**Matrix: Sediment**		**Batch: 6030213**			
% Solids	**50.9**	---	1.00	% by Weight	1	03/09/16 09:12	EPA 8000C	
SIL-04 (A6C0180-05)			**Matrix: Sediment**		**Batch: 6030213**			
% Solids	**72.1**	---	1.00	% by Weight	1	03/09/16 09:12	EPA 8000C	
SIL-05 (A6C0180-06)			**Matrix: Sediment**		**Batch: 6030213**			
% Solids	**34.9**	---	1.00	% by Weight	1	03/09/16 09:12	EPA 8000C	
SIL-06 (A6C0180-07)			**Matrix: Sediment**		**Batch: 6030213**			
% Solids	**33.9**	---	1.00	% by Weight	1	03/09/16 09:12	EPA 8000C	
SIL-07 (A6C0180-08)			**Matrix: Sediment**		**Batch: 6030213**			
% Solids	**36.9**	---	1.00	% by Weight	1	03/09/16 09:12	EPA 8000C	
SIL-08 (A6C0180-09)			**Matrix: Sediment**		**Batch: 6030213**			
% Solids	**36.3**	---	1.00	% by Weight	1	03/09/16 09:12	EPA 8000C	
SIL-09 (A6C0180-10)			**Matrix: Sediment**		**Batch: 6030213**			
% Solids	**34.2**	---	1.00	% by Weight	1	03/09/16 09:12	EPA 8000C	
SIL-10 (A6C0180-11)			**Matrix: Sediment**		**Batch: 6030213**			
% Solids	**36.3**	---	1.00	% by Weight	1	03/09/16 09:12	EPA 8000C	
SIL-11 (A6C0180-12)			**Matrix: Sediment**		**Batch: 6030213**			
% Solids	**30.4**	---	1.00	% by Weight	1	03/09/16 09:12	EPA 8000C	
SIL-12 (A6C0180-13)			**Matrix: Sediment**		**Batch: 6030213**			
% Solids	**32.7**	---	1.00	% by Weight	1	03/09/16 09:12	EPA 8000C	
SIL-13 (A6C0180-14)			**Matrix: Sediment**		**Batch: 6030213**			
% Solids	**36.2**	---	1.00	% by Weight	1	03/09/16 09:12	EPA 8000C	
SIL-14 (A6C0180-15)			**Matrix: Sediment**		**Batch: 6030213**			
% Solids	**31.5**	---	1.00	% by Weight	1	03/09/16 09:12	EPA 8000C	
SIL-15 (A6C0180-16)			**Matrix: Sediment**		**Batch: 6030213**			
% Solids	**78.8**	---	1.00	% by Weight	1	03/09/16 09:12	EPA 8000C	

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GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

ANALYTICAL SAMPLE RESULTS

Percent Dry Weight

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
SIL-16 (A6C0180-17)			**Matrix: Sediment**		**Batch: 6030213**			
% Solids	**30.8**	---	1.00	% by Weight	1	03/09/16 09:12	EPA 8000C	
SIL-17 (A6C0180-18)			**Matrix: Sediment**		**Batch: 6030213**			
% Solids	**34.2**	---	1.00	% by Weight	1	03/09/16 09:12	EPA 8000C	
SIL-18 (A6C0180-19)			**Matrix: Sediment**		**Batch: 6030213**			
% Solids	**35.0**	---	1.00	% by Weight	1	03/09/16 09:12	EPA 8000C	
SIL-19 (A6C0180-20)			**Matrix: Sediment**		**Batch: 6030213**			
% Solids	**34.2**	---	1.00	% by Weight	1	03/09/16 09:12	EPA 8000C	
SIL-20 (A6C0180-21)			**Matrix: Sediment**		**Batch: 6030213**			
% Solids	**34.6**	---	1.00	% by Weight	1	03/09/16 09:12	EPA 8000C	
SIL-21 (A6C0180-22)			**Matrix: Sediment**		**Batch: 6030213**			
% Solids	**35.8**	---	1.00	% by Weight	1	03/09/16 09:12	EPA 8000C	
SIL-00-RSM (A6C0180-23)			**Matrix: Sediment**		**Batch: 6030792**			
% Solids	**95.5**	---	1.00	% by Weight	1	03/25/16 09:05	EPA 8000C	
SIL-01-RSM (A6C0180-24)			**Matrix: Sediment**		**Batch: 6030792**			
% Solids	**95.6**	---	1.00	% by Weight	1	03/25/16 09:05	EPA 8000C	
SIL-02-RSM (A6C0180-25)			**Matrix: Sediment**		**Batch: 6030792**			
% Solids	**96.0**	---	1.00	% by Weight	1	03/25/16 09:05	EPA 8000C	
SIL-03-RSM (A6C0180-26)			**Matrix: Sediment**		**Batch: 6030792**			
% Solids	**96.5**	---	1.00	% by Weight	1	03/25/16 09:05	EPA 8000C	
SIL-04-RSM (A6C0180-27)			**Matrix: Sediment**		**Batch: 6030792**			
% Solids	**97.6**	---	1.00	% by Weight	1	03/25/16 09:05	EPA 8000C	
SIL-05-RSM (A6C0180-28)			**Matrix: Sediment**		**Batch: 6030792**			
% Solids	**94.7**	---	1.00	% by Weight	1	03/25/16 09:05	EPA 8000C	
SIL-06-RSM (A6C0180-29)			**Matrix: Sediment**		**Batch: 6030792**			
% Solids	**94.7**	---	1.00	% by Weight	1	03/25/16 09:05	EPA 8000C	
SIL-07-RSM (A6C0180-30)			**Matrix: Sediment**		**Batch: 6030792**			
% Solids	**95.4**	---	1.00	% by Weight	1	03/25/16 09:05	EPA 8000C	
SIL-08-RSM (A6C0180-31)			**Matrix: Sediment**		**Batch: 6030792**			
% Solids	**94.9**	---	1.00	% by Weight	1	03/25/16 09:05	EPA 8000C	
SIL-09-RSM (A6C0180-32)			**Matrix: Sediment**		**Batch: 6030792**			

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AMENDED REPORT

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GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

ANALYTICAL SAMPLE RESULTS

Percent Dry Weight

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
SIL-09-RSM (A6C0180-32)			**Matrix: Sediment**		**Batch: 6030792**			
% Solids	**94.8**	---	1.00	% by Weight	1	03/25/16 09:05	EPA 8000C	
SIL-10-RSM (A6C0180-33)			**Matrix: Sediment**		**Batch: 6030792**			
% Solids	**94.7**	---	1.00	% by Weight	1	03/25/16 09:05	EPA 8000C	
SIL-11-RSM (A6C0180-34)			**Matrix: Sediment**		**Batch: 6030792**			
% Solids	**94.5**	---	1.00	% by Weight	1	03/25/16 09:05	EPA 8000C	
SIL-12-RSM (A6C0180-35)			**Matrix: Sediment**		**Batch: 6030792**			
% Solids	**95.0**	---	1.00	% by Weight	1	03/25/16 09:05	EPA 8000C	
SIL-13-RSM (A6C0180-36)			**Matrix: Sediment**		**Batch: 6030792**			
% Solids	**95.2**	---	1.00	% by Weight	1	03/25/16 09:05	EPA 8000C	
SIL-14-RSM (A6C0180-37)			**Matrix: Sediment**		**Batch: 6030792**			
% Solids	**95.1**	---	1.00	% by Weight	1	03/25/16 09:05	EPA 8000C	
SIL-15-RSM (A6C0180-38)			**Matrix: Sediment**		**Batch: 6030792**			
% Solids	**98.6**	---	1.00	% by Weight	1	03/25/16 09:05	EPA 8000C	
SIL-16-RSM (A6C0180-39)			**Matrix: Sediment**		**Batch: 6030792**			
% Solids	**94.5**	---	1.00	% by Weight	1	03/25/16 09:05	EPA 8000C	
SIL-17-RSM (A6C0180-40)			**Matrix: Sediment**		**Batch: 6030792**			
% Solids	**94.8**	---	1.00	% by Weight	1	03/25/16 09:05	EPA 8000C	
SIL-18-RSM (A6C0180-41)			**Matrix: Sediment**		**Batch: 6030792**			
% Solids	**95.0**	---	1.00	% by Weight	1	03/25/16 09:05	EPA 8000C	
SIL-19-RSM (A6C0180-42)			**Matrix: Sediment**		**Batch: 6030792**			
% Solids	**94.7**	---	1.00	% by Weight	1	03/25/16 09:05	EPA 8000C	
SIL-20-RSM (A6C0180-43)			**Matrix: Sediment**		**Batch: 6030792**			
% Solids	**94.6**	---	1.00	% by Weight	1	03/25/16 09:05	EPA 8000C	
SIL-21-RSM (A6C0180-44)			**Matrix: Sediment**		**Batch: 6030792**			
% Solids	**95.1**	---	1.00	% by Weight	1	03/25/16 09:05	EPA 8000C	

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AMENDED REPORT

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Project: **Portland Harbor Sediment**
Project Number: HPH100D
Project Manager: Keith Kroeger

Reported: 08/12/16 11:59

QUALITY CONTROL (QC) SAMPLE RESULTS

Polychlorinated Biphenyls -- EPA 8082A

Analyte	Result	MDL	Reporting Limit	Units	Dil.	Spike Amount	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 6030837 - EPA 3546							**Sediment**					
Blank (6030837-BLK1)						Prepared: 03/25/16 10:30	Analyzed: 03/28/16 16:34					C-07
EPA 8082A												
Aroclor 1016	ND	0.648	1.29	ug/kg wet	1	---	---	---	---	---	---	
Aroclor 1221	ND	0.648	1.29	"	"	---	---	---	---	---	---	
Aroclor 1232	ND	0.648	1.29	"	"	---	---	---	---	---	---	
Aroclor 1242	ND	0.648	1.29	"	"	---	---	---	---	---	---	
Aroclor 1248	ND	0.648	1.29	"	"	---	---	---	---	---	---	
Aroclor 1254	ND	0.648	1.29	"	"	---	---	---	---	---	---	
Aroclor 1260	ND	0.648	1.29	"	"	---	---	---	---	---	---	
Aroclor 1262	ND	0.648	1.29	"	"	---	---	---	---	---	---	
Aroclor 1268	ND	0.648	1.29	"	"	---	---	---	---	---	---	
Surr: Decachlorobiphenyl (Surr)			*Recovery: 84 %*	*Limits: 44-120 %*			*Dilution: 1x*					
LCS (6030837-BS1)						Prepared: 03/25/16 10:30	Analyzed: 03/28/16 16:53					C-07
EPA 8082A												
Aroclor 1016	59.4	0.670	1.33	ug/kg wet	1	83.3	---	71	47-134%	---	---	
Aroclor 1260	77.5	0.670	1.33	"	"	"	---	93	53-140%	---	---	
Surr: Decachlorobiphenyl (Surr)			*Recovery: 90 %*	*Limits: 44-120 %*			*Dilution: 1x*					
Duplicate (6030837-DUP1)						Prepared: 03/25/16 10:30	Analyzed: 03/28/16 18:06					C-07
QC Source Sample: SIL-20-RSM (A6C0180-43)												
EPA 8082A												
Aroclor 1016	ND	0.687	1.36	ug/kg dry	1	---	ND	---	---	---	30%	
Aroclor 1221	ND	0.687	1.36	"	"	---	ND	---	---	---	30%	
Aroclor 1232	ND	0.687	1.36	"	"	---	ND	---	---	---	30%	
Aroclor 1242	ND	0.687	1.36	"	"	---	ND	---	---	---	30%	
Aroclor 1248	ND	0.687	1.36	"	"	---	ND	---	---	---	30%	
Aroclor 1254	**21.9**	0.687	1.36	"	"	---	27.8	---	---	24	30%	P-10
Aroclor 1260	**30.9**	0.687	1.36	"	"	---	38.1	---	---	21	30%	P-10
Aroclor 1262	ND	0.687	1.36	"	"	---	ND	---	---	---	30%	
Aroclor 1268	ND	0.687	1.36	"	"	---	ND	---	---	---	30%	
Surr: Decachlorobiphenyl (Surr)			*Recovery: 61 %*	*Limits: 44-120 %*			*Dilution: 1x*					

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AMENDED REPORT

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GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

QUALITY CONTROL (QC) SAMPLE RESULTS

Polychlorinated Biphenyls -- EPA 8082A

Analyte	Result	MDL	Reporting Limit	Units	Dil.	Spike Amount	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 6030897 - EPA 3546							**Sediment**					
Blank (6030897-BLK1)						Prepared: 03/28/16 13:12	Analyzed: 03/29/16 17:30					C-07
EPA 8082A												
Aroclor 1016	ND	0.648	1.29	ug/kg wet	1	---	---	---	---	---	---	
Aroclor 1221	ND	0.648	1.29	"	"	---	---	---	---	---	---	
Aroclor 1232	ND	0.648	1.29	"	"	---	---	---	---	---	---	
Aroclor 1242	ND	0.648	1.29	"	"	---	---	---	---	---	---	
Aroclor 1248	ND	0.648	1.29	"	"	---	---	---	---	---	---	
Aroclor 1254	ND	0.648	1.29	"	"	---	---	---	---	---	---	
Aroclor 1260	ND	0.648	1.29	"	"	---	---	---	---	---	---	
Aroclor 1262	ND	0.648	1.29	"	"	---	---	---	---	---	---	
Aroclor 1268	ND	0.648	1.29	"	"	---	---	---	---	---	---	
Surr: Decachlorobiphenyl (Surr)			*Recovery: 97 %*	*Limits: 44-120 %*			*Dilution: 1x*					
LCS (6030897-BS1)						Prepared: 03/28/16 13:12	Analyzed: 03/29/16 17:49					C-07
EPA 8082A												
Aroclor 1016	59.7	0.670	1.33	ug/kg wet	1	83.3	---	72	47-134%	---	---	
Aroclor 1260	83.0	0.670	1.33	"	"	"	---	100	53-140%	---	---	
Surr: Decachlorobiphenyl (Surr)			*Recovery: 104 %*	*Limits: 44-120 %*			*Dilution: 1x*					
LCS Dup (6030897-BSD1)						Prepared: 03/28/16 13:12	Analyzed: 03/29/16 18:08					C-07, Q-19
EPA 8082A												
Aroclor 1016	58.7	0.670	1.33	ug/kg wet	1	83.3	---	70	47-134%	2	30%	
Aroclor 1260	83.9	0.670	1.33	"	"	"	---	101	53-140%	1	30%	
Surr: Decachlorobiphenyl (Surr)			*Recovery: 106 %*	*Limits: 44-120 %*			*Dilution: 1x*					

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AMENDED REPORT

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GeoSyntec	Project: Portland Harbor Sediment	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

QUALITY CONTROL (QC) SAMPLE RESULTS

Polychlorinated Biphenyls -- EPA 8082A

Analyte	Result	MDL	Reporting Limit	Units	Dil.	Spike Amount	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 6030915 - EPA 3546							**Sediment**					
Blank (6030915-BLK1)						Prepared: 03/29/16 09:23	Analyzed: 03/29/16 17:35					C-07
EPA 8082A												
Aroclor 1016	ND	0.574	1.14	ug/kg wet	1	---	---	---	---	---	---	
Aroclor 1221	ND	0.574	1.14	"	"	---	---	---	---	---	---	
Aroclor 1232	ND	0.574	1.14	"	"	---	---	---	---	---	---	
Aroclor 1242	ND	0.574	1.14	"	"	---	---	---	---	---	---	
Aroclor 1248	ND	0.574	1.14	"	"	---	---	---	---	---	---	
Aroclor 1254	ND	0.574	1.14	"	"	---	---	---	---	---	---	
Aroclor 1260	ND	0.574	1.14	"	"	---	---	---	---	---	---	
Aroclor 1262	ND	0.574	1.14	"	"	---	---	---	---	---	---	
Aroclor 1268	ND	0.574	1.14	"	"	---	---	---	---	---	---	
Surr: Decachlorobiphenyl (Surr)			*Recovery: 89 %*	*Limits: 44-120 %*			*Dilution: 1x*					
LCS (6030915-BS1)						Prepared: 03/29/16 09:23	Analyzed: 03/29/16 17:53					C-07
EPA 8082A												
Aroclor 1016	50.5	0.670	1.33	ug/kg wet	1	83.3	---	61	47-134%	---	---	
Aroclor 1260	72.8	0.670	1.33	"	"	"	---	87	53-140%	---	---	
Surr: Decachlorobiphenyl (Surr)			*Recovery: 85 %*	*Limits: 44-120 %*			*Dilution: 1x*					
LCS Dup (6030915-BSD1)						Prepared: 03/29/16 09:56	Analyzed: 03/29/16 18:12					C-07, Q-19
EPA 8082A												
Aroclor 1016	48.7	0.670	1.33	ug/kg wet	1	83.3	---	58	47-134%	4	30%	
Aroclor 1260	72.9	0.670	1.33	"	"	"	---	87	53-140%	0.04	30%	
Surr: Decachlorobiphenyl (Surr)			*Recovery: 93 %*	*Limits: 44-120 %*			*Dilution: 1x*					

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GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

QUALITY CONTROL (QC) SAMPLE RESULTS

Conventional Chemistry Parameters

Analyte	Result	MDL	Reporting Limit	Units	Dil.	Spike Amount	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 6030253 - PSEP TOC							**Soil**					
Blank (6030253-BLK1)					Prepared: 03/09/16 09:55		Analyzed: 03/17/16 17:20					
SM 5310B MOD												
Total Organic Carbon	ND	---	200	mg/kg	1	---	---	---	---	---	---	
LCS (6030253-BS1)					Prepared: 03/09/16 09:55		Analyzed: 03/17/16 17:20					
SM 5310B MOD												
Total Organic Carbon	10000	---		mg/kg	1	10000	---	102	85-115%	---	---	
Duplicate (6030253-DUP1)					Prepared: 03/09/16 09:55		Analyzed: 03/17/16 17:20					
QC Source Sample: SIL-00 (A6C0180-01)												
SM 5310B MOD												
Total Organic Carbon	**18000**	---	200	mg/kg	1	---	18000	---	---	4	20%	
Duplicate (6030253-DUP2)					Prepared: 03/09/16 09:55		Analyzed: 03/17/16 17:20					
QC Source Sample: SIL-10 (A6C0180-11)												
SM 5310B MOD												
Total Organic Carbon	**19000**	---	200	mg/kg	1	---	19000	---	---	0.5	20%	

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GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

QUALITY CONTROL (QC) SAMPLE RESULTS

Percent Dry Weight

Analyte	Result	MDL	Reporting Limit	Units	Dil.	Spike Amount	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 6030213 - Total Solids (Dry Weight)							**Soil**					
Duplicate (6030213-DUPA)						Prepared: 03/08/16 14:37 Analyzed: 03/09/16 09:12						
QC Source Sample: SIL-06 (A6C0180-07)												
EPA 8000C												
% Solids	**35.5**	---	1.00	% by Weight	1	---	33.9	---	---	4	10%	
Duplicate (6030213-DUPB)						Prepared: 03/08/16 14:37 Analyzed: 03/09/16 09:12						
QC Source Sample: SIL-14 (A6C0180-15)												
EPA 8000C												
% Solids	**31.9**	---	1.00	% by Weight	1	---	31.5	---	---	1	10%	

No Client related Batch QC samples analyzed for this batch. See notes page for more information.

Batch 6030792 - Total Solids (Dry Weight) — **Soil**

No Client related Batch QC samples analyzed for this batch. See notes page for more information.

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GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

SAMPLE PREPARATION INFORMATION

Polychlorinated Biphenyls -- EPA 8082A

Prep: EPA 3546

Lab Number	Matrix	Method	Sampled	Prepared	Sample Initial/Final	Default Initial/Final	RL Prep Factor
Batch: 6030837							
A6C0180-43	Sediment	EPA 8082A	03/04/16 00:00	03/25/16 10:30	30.58g/2mL	30g/2mL	0.98
A6C0180-44RE1	Sediment	EPA 8082A	03/04/16 00:00	03/25/16 10:30	30.86g/2mL	30g/2mL	0.97
Batch: 6030897							
A6C0180-23RE1	Sediment	EPA 8082A	03/04/16 11:35	03/28/16 13:12	27.21g/2mL	30g/2mL	1.10
A6C0180-24RE1	Sediment	EPA 8082A	03/04/16 11:48	03/28/16 13:12	29.21g/2mL	30g/2mL	1.03
A6C0180-25RE1	Sediment	EPA 8082A	03/04/16 11:20	03/28/16 13:12	30.11g/2mL	30g/2mL	1.00
A6C0180-26RE1	Sediment	EPA 8082A	03/04/16 11:14	03/28/16 13:12	30.74g/2mL	30g/2mL	0.98
A6C0180-27RE2	Sediment	EPA 8082A	03/04/16 11:03	03/28/16 13:12	30.88g/2mL	30g/2mL	0.97
A6C0180-28RE2	Sediment	EPA 8082A	03/04/16 10:51	03/28/16 13:12	30.53g/2mL	30g/2mL	0.98
A6C0180-29RE2	Sediment	EPA 8082A	03/04/16 11:55	03/28/16 13:12	29.34g/2mL	30g/2mL	1.02
A6C0180-30RE2	Sediment	EPA 8082A	03/04/16 10:40	03/28/16 13:12	30.22g/2mL	30g/2mL	0.99
A6C0180-31RE2	Sediment	EPA 8082A	03/04/16 10:25	03/28/16 13:12	30.27g/2mL	30g/2mL	0.99
A6C0180-32RE2	Sediment	EPA 8082A	03/04/16 10:21	03/28/16 13:12	30.14g/2mL	30g/2mL	1.00
Batch: 6030915							
A6C0180-33RE2	Sediment	EPA 8082A	03/04/16 10:11	03/29/16 09:23	30.49g/2mL	30g/2mL	0.98
A6C0180-34RE2	Sediment	EPA 8082A	03/04/16 10:02	03/29/16 09:23	19.99g/2mL	30g/2mL	1.50
A6C0180-35RE1	Sediment	EPA 8082A	03/04/16 09:54	03/29/16 09:23	30.56g/2mL	30g/2mL	0.98
A6C0180-36RE1	Sediment	EPA 8082A	03/04/16 09:45	03/29/16 09:23	30.55g/2mL	30g/2mL	0.98
A6C0180-37RE1	Sediment	EPA 8082A	03/04/16 09:36	03/29/16 09:23	29.74g/2mL	30g/2mL	1.01
A6C0180-38RE1	Sediment	EPA 8082A	03/04/16 09:25	03/29/16 09:23	34.57g/2mL	30g/2mL	0.87
A6C0180-39RE1	Sediment	EPA 8082A	03/04/16 09:05	03/29/16 09:23	30.82g/2mL	30g/2mL	0.97
A6C0180-40RE1	Sediment	EPA 8082A	03/04/16 08:54	03/29/16 09:23	29.37g/2mL	30g/2mL	1.02
A6C0180-41RE1	Sediment	EPA 8082A	03/04/16 08:15	03/29/16 09:23	30.13g/2mL	30g/2mL	1.00
A6C0180-42RE1	Sediment	EPA 8082A	03/04/16 08:36	03/29/16 09:23	20.78g/2mL	30g/2mL	1.44

Conventional Chemistry Parameters

Prep: PSEP TOC

Lab Number	Matrix	Method	Sampled	Prepared	Sample Initial/Final	Default Initial/Final	RL Prep Factor
Batch: 6030253							
A6C0180-01	Sediment	SM 5310B MOD	03/04/16 11:35	03/09/16 09:55	5g/5g	5g/5g	NA
A6C0180-02	Sediment	SM 5310B MOD	03/04/16 11:48	03/09/16 09:55	5g/5g	5g/5g	NA
A6C0180-03	Sediment	SM 5310B MOD	03/04/16 11:20	03/09/16 09:55	5g/5g	5g/5g	NA
A6C0180-04	Sediment	SM 5310B MOD	03/04/16 11:14	03/09/16 09:55	5g/5g	5g/5g	NA

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Lisa Domenighini, Client Services Manager

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AMENDED REPORT

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GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

SAMPLE PREPARATION INFORMATION

Conventional Chemistry Parameters

Prep: PSEP TOC

Lab Number	Matrix	Method	Sampled	Prepared	Sample Initial/Final	Default Initial/Final	RL Prep Factor
A6C0180-05	Sediment	SM 5310B MOD	03/04/16 11:03	03/09/16 09:55	5g/5g	5g/5g	NA
A6C0180-06	Sediment	SM 5310B MOD	03/04/16 10:51	03/09/16 09:55	5g/5g	5g/5g	NA
A6C0180-07	Sediment	SM 5310B MOD	03/04/16 11:55	03/09/16 09:55	5g/5g	5g/5g	NA
A6C0180-08	Sediment	SM 5310B MOD	03/04/16 10:40	03/09/16 09:55	5g/5g	5g/5g	NA
A6C0180-09	Sediment	SM 5310B MOD	03/04/16 10:25	03/09/16 09:55	5g/5g	5g/5g	NA
A6C0180-10	Sediment	SM 5310B MOD	03/04/16 10:21	03/09/16 09:55	5g/5g	5g/5g	NA
A6C0180-11	Sediment	SM 5310B MOD	03/04/16 10:11	03/09/16 09:55	5g/5g	5g/5g	NA
A6C0180-12	Sediment	SM 5310B MOD	03/04/16 10:02	03/09/16 09:55	5g/5g	5g/5g	NA
A6C0180-13	Sediment	SM 5310B MOD	03/04/16 09:54	03/09/16 09:55	5g/5g	5g/5g	NA
A6C0180-14	Sediment	SM 5310B MOD	03/04/16 09:45	03/09/16 09:55	5g/5g	5g/5g	NA
A6C0180-15	Sediment	SM 5310B MOD	03/04/16 09:36	03/09/16 09:55	5g/5g	5g/5g	NA
A6C0180-16	Sediment	SM 5310B MOD	03/04/16 09:25	03/09/16 09:55	5g/5g	5g/5g	NA
A6C0180-17	Sediment	SM 5310B MOD	03/04/16 09:05	03/09/16 09:55	5g/5g	5g/5g	NA
A6C0180-18	Sediment	SM 5310B MOD	03/04/16 08:54	03/09/16 09:55	5g/5g	5g/5g	NA
A6C0180-19	Sediment	SM 5310B MOD	03/04/16 08:15	03/09/16 09:55	5g/5g	5g/5g	NA
A6C0180-20	Sediment	SM 5310B MOD	03/04/16 08:36	03/09/16 09:55	5g/5g	5g/5g	NA

Grain Size by ASTM D 422m/PSET Parameters

Prep: ASTM D 421

Lab Number	Matrix	Method	Sampled	Prepared	Sample Initial/Final	Default Initial/Final	RL Prep Factor
Batch: 6030284							
A6C0180-01	Sediment	ASTM D 422m	03/04/16 11:35	03/09/16 12:15	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-02	Sediment	ASTM D 422m	03/04/16 11:48	03/09/16 12:25	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-03	Sediment	ASTM D 422m	03/04/16 11:20	03/09/16 12:32	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-04	Sediment	ASTM D 422m	03/04/16 11:14	03/09/16 12:41	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-05	Sediment	ASTM D 422m	03/04/16 11:03	03/09/16 12:49	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-06	Sediment	ASTM D 422m	03/04/16 10:51	03/09/16 13:00	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-07	Sediment	ASTM D 422m	03/04/16 11:55	03/09/16 13:10	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-08	Sediment	ASTM D 422m	03/04/16 10:40	03/09/16 13:21	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-09	Sediment	ASTM D 422m	03/04/16 10:25	03/09/16 13:31	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-10	Sediment	ASTM D 422m	03/04/16 10:21	03/09/16 13:43	1N/A/1N/A	1N/A/1N/A	NA
Batch: 6030469							
A6C0180-11	Sediment	ASTM D 422m	03/04/16 10:11	03/15/16 11:03	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-12	Sediment	ASTM D 422m	03/04/16 10:02	03/15/16 11:14	1N/A/1N/A	1N/A/1N/A	NA

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GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

SAMPLE PREPARATION INFORMATION

Grain Size by ASTM D 422m/PSET Parameters

Prep: ASTM D 421

Lab Number	Matrix	Method	Sampled	Prepared	Sample Initial/Final	Default Initial/Final	RL Prep Factor
A6C0180-13	Sediment	ASTM D 422m	03/04/16 09:54	03/15/16 11:26	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-14	Sediment	ASTM D 422m	03/04/16 09:45	03/15/16 11:36	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-15	Sediment	ASTM D 422m	03/04/16 09:36	03/15/16 11:44	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-16	Sediment	ASTM D 422m	03/04/16 09:25	03/15/16 11:57	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-17	Sediment	ASTM D 422m	03/04/16 09:05	03/15/16 12:08	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-18	Sediment	ASTM D 422m	03/04/16 08:54	03/15/16 12:17	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-19	Sediment	ASTM D 422m	03/04/16 08:15	03/15/16 12:28	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-20	Sediment	ASTM D 422m	03/04/16 08:36	03/15/16 12:42	1N/A/1N/A	1N/A/1N/A	NA

Percent Dry Weight

Prep: Total Solids (Dry Weight)

Lab Number	Matrix	Method	Sampled	Prepared	Sample Initial/Final	Default Initial/Final	RL Prep Factor
Batch: 6030213							
A6C0180-01	Sediment	EPA 8000C	03/04/16 11:35	03/08/16 14:37	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-02	Sediment	EPA 8000C	03/04/16 11:48	03/08/16 14:37	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-03	Sediment	EPA 8000C	03/04/16 11:20	03/08/16 14:37	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-04	Sediment	EPA 8000C	03/04/16 11:14	03/08/16 14:37	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-05	Sediment	EPA 8000C	03/04/16 11:03	03/08/16 14:37	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-06	Sediment	EPA 8000C	03/04/16 10:51	03/08/16 14:37	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-07	Sediment	EPA 8000C	03/04/16 11:55	03/08/16 14:37	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-08	Sediment	EPA 8000C	03/04/16 10:40	03/08/16 14:37	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-09	Sediment	EPA 8000C	03/04/16 10:25	03/08/16 14:37	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-10	Sediment	EPA 8000C	03/04/16 10:21	03/08/16 14:37	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-11	Sediment	EPA 8000C	03/04/16 10:11	03/08/16 14:37	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-12	Sediment	EPA 8000C	03/04/16 10:02	03/08/16 14:37	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-13	Sediment	EPA 8000C	03/04/16 09:54	03/08/16 14:37	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-14	Sediment	EPA 8000C	03/04/16 09:45	03/08/16 14:37	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-15	Sediment	EPA 8000C	03/04/16 09:36	03/08/16 14:37	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-16	Sediment	EPA 8000C	03/04/16 09:25	03/08/16 14:37	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-17	Sediment	EPA 8000C	03/04/16 09:05	03/08/16 14:37	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-18	Sediment	EPA 8000C	03/04/16 08:54	03/08/16 14:37	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-19	Sediment	EPA 8000C	03/04/16 08:15	03/08/16 14:37	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-20	Sediment	EPA 8000C	03/04/16 08:36	03/08/16 14:37	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-21	Sediment	EPA 8000C	03/04/16 00:00	03/08/16 14:37	1N/A/1N/A	1N/A/1N/A	NA

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GeoSyntec	Project: Portland Harbor Sediment	
621 SW Morrison St, Suite 600	Project Number: HPH100D	Reported:
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

SAMPLE PREPARATION INFORMATION

Percent Dry Weight

Prep: Total Solids (Dry Weight)

Lab Number	Matrix	Method	Sampled	Prepared	Sample Initial/Final	Default Initial/Final	RL Prep Factor
A6C0180-22	Sediment	EPA 8000C	03/04/16 00:00	03/08/16 14:37	1N/A/1N/A	1N/A/1N/A	NA
Batch: 6030792							
A6C0180-23	Sediment	EPA 8000C	03/04/16 11:35	03/24/16 10:49	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-24	Sediment	EPA 8000C	03/04/16 11:48	03/24/16 10:49	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-25	Sediment	EPA 8000C	03/04/16 11:20	03/24/16 10:49	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-26	Sediment	EPA 8000C	03/04/16 11:14	03/24/16 10:49	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-27	Sediment	EPA 8000C	03/04/16 11:03	03/24/16 10:49	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-28	Sediment	EPA 8000C	03/04/16 10:51	03/24/16 10:49	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-29	Sediment	EPA 8000C	03/04/16 11:55	03/24/16 10:49	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-30	Sediment	EPA 8000C	03/04/16 10:40	03/24/16 10:49	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-31	Sediment	EPA 8000C	03/04/16 10:25	03/24/16 10:48	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-32	Sediment	EPA 8000C	03/04/16 10:21	03/24/16 10:48	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-33	Sediment	EPA 8000C	03/04/16 10:11	03/24/16 10:48	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-34	Sediment	EPA 8000C	03/04/16 10:02	03/24/16 10:48	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-35	Sediment	EPA 8000C	03/04/16 09:54	03/24/16 10:48	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-36	Sediment	EPA 8000C	03/04/16 09:45	03/24/16 10:48	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-37	Sediment	EPA 8000C	03/04/16 09:36	03/24/16 10:48	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-38	Sediment	EPA 8000C	03/04/16 09:25	03/24/16 10:48	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-39	Sediment	EPA 8000C	03/04/16 09:05	03/24/16 10:48	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-40	Sediment	EPA 8000C	03/04/16 08:54	03/24/16 10:48	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-41	Sediment	EPA 8000C	03/04/16 08:15	03/24/16 10:48	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-42	Sediment	EPA 8000C	03/04/16 08:36	03/24/16 10:48	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-43	Sediment	EPA 8000C	03/04/16 00:00	03/24/16 10:48	1N/A/1N/A	1N/A/1N/A	NA
A6C0180-44	Sediment	EPA 8000C	03/04/16 00:00	03/24/16 10:48	1N/A/1N/A	1N/A/1N/A	NA

Apex Labs

AMENDED REPORT

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

Notes and Definitions

Qualifiers:

C-07	Extract has undergone Sulfuric Acid Cleanup by EPA 3665A, Sulfur Cleanup by EPA 3660B, and Florisil Cleanup by EPA 3620B in order to minimize matrix interference.
GS-01	See detailed Particle Size Analysis results, accumulation curves, and Case Narratives at the end of this report.
P-10	Result estimated due to the presence of multiple PCB Aroclors and/or matrix interference.
Q-19	Blank Spike Duplicate (BSD) sample analyzed in place of Matrix Spike/Duplicate samples due to limited sample amount available for analysis.

Notes and Conventions:

DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis. Results listed as 'wet' or without 'dry'designation are not dry weight corrected.
RPD	Relative Percent Difference
MDL	If MDL is not listed, data has been evaluated to the Method Reporting Limit only.
WMSC	Water Miscible Solvent Correction has been applied to Results and MRLs for volatiles soil samples per EPA 8000C.
Batch QC	Unless specifically requested, this report contains only results for Batch QC derived from client samples included in this report. All analyses were performed with the appropriate Batch QC (including Sample Duplicates, Matrix Spikes and/or Matrix Spike Duplicates) in order to meet or exceed method and regulatory requirements. Any exceptions to this will be qualified in this report. Complete Batch QC results are available upon request. In cases where there is insufficient sample provided for Sample Duplicates and/or Matrix Spikes, a Lab Control Sample Duplicate (LCS Dup) is analyzed to demonstrate accuracy and precision of the extraction and analysis.
Blank Policy	Apex assesses blank data for potential high bias down to a level equal to ½ the method reporting limit (MRL), except for conventional chemistry and HCID analyses which are assessed only to the MRL. Sample results flagged with a B or B-02 qualifier are potentially biased high if they are less than ten times the level found in the blank for inorganic analyses or less than five times the level found in the blank for organic analyses. For accurate comparison of volatile results to the level found in the blank; water sample results should be divided by the dilution factor, and soil sample results should be divided by 1/50 of the sample dilution to account for the sample prep factor. Results qualified as reported below the MRL may include a potential high bias if associated with a B or B-02 qualified blank. B and B-02 qualifications are not applied to J qualified results reported below the MRL.
---	QC results are not applicable. For example, % Recoveries for Blanks and Duplicates, % RPD for Blanks, Blank Spikes and Matrix Spikes, etc.
***	Used to indicate a possible discrepancy with the Sample and Sample Duplicate results when the %RPD is not available. In this case, either the Sample or the Sample Duplicate has a reportable result for this analyte, while the other is Non Detect (ND).

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

APEX LABS **CHAIN OF CUSTODY** Lab # A6C0180 COC 1 of 3

12232 S.W. Garden Place, Tigard, OR 97223 Ph: 503-718-2323 Fax: 503-718-0333

Company: GEOSYNTEC Project Mgr: KEITH KROEGER Project Name: PORTLAND HARBOR Project #: HPH100D

Address: 621 SW MORRISON ST STE 600 PORTLAND Phone: 971 271 5987 Fax: 971 271 5884 Email: kkroeger@geosyntec.com

Sampled by:

Site Location: (OR) WA Other: ______

ANALYSIS REQUEST

	SAMPLE ID	LAB ID #	DATE	TIME	MATRIX	# OF CONTAINERS	NWTPH-HCID	NWTPH-Dx	NWTPH-Gx	8260 VOC	8260 RBDM VOCs	8260 BTEX	8270 SVOC	8270 SIM PAHs	8082 PCBs	600 TTO	RCRA Metals (8)	TCLP Metals (8)	Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Hg, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Tl, V, Zn TOTAL DISS TCLP	1200-COLS	1200-Z	Grain Size	TOC					
SIL AC	-00		3/4	11:35	Sed	2									X							X	X					
SIL	-01		3/4	11:48	Sed	2									X							X	X					
SIL	-02		3/4	11:20	Sed	2									X							X	X					
SIL	-03		3/4	11:14	Sed	2									X							X	X					
SIL	-04		3/4	11:03	Sed	2									X							X	X					
SIL	-05		3/4	10:51	Sed	2									X							X	X					
SIL	-06		3/4	11:55	Sed	2									X							X	X					
SIL	-07		3/4	10:40	Sed	2									X							X	X					
SIL	-08		3/4	10:25	Sed	2									X							X	X					
SIL	-09		3/4	10:21	Sed	2									X							X	X					

Normal Turn Around Time (TAT) = 7-10 Business Days (YES) NO

TAT Requested (circle): 1 Day 2 Day 3 Day 4 DAY 5 DAY Other: ______

SAMPLES ARE HELD FOR 30 DAYS

SPECIAL INSTRUCTIONS:
PCBs - EPA 8082A
TOC - SM 5310 B MOD
Grain size - ASTM D 422M

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature: [signature] Date: 3/4	Signature: [signature] Date: 3/4	Signature: Date:	Signature: Date:
Printed Name: Alison Clement Time: 13:00	Printed Name: J Smith Time: 13:00	Printed Name: Time:	Printed Name: Time:
Company: GEOSYNTEC	Company: Apex	Company:	Company:

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

GeoSyntec 621 SW Morrison St, Suite 600 Portland, OR 97204	Project: **Portland Harbor Sediment** Project Number: HPH100D Project Manager: Keith Kroeger	**Reported:** 08/12/16 11:59

APEX LABS **CHAIN OF CUSTODY** Lab # A6C0180 COC 2 of 3

12232 S.W. Garden Place, Tigard, OR 97223 Ph: 503-718-2323 Fax: 503-718-0333

Company: GEOSYNTEC Project Mgr: KEITH KROEGER Project Name: PORTLAND HARBOR Project # HPH100D

Address: 621 SW MORRISON ST STE 600 PORTLAND Phone: 971 271 5901 Fax: 971 271 5884 Email: kkroeger@geosyntec.com

Sampled by:

Site Location: OR WA Other:

ANALYSIS REQUEST

	SAMPLE ID	LAB ID #	DATE	TIME	MATRIX	# OF CONTAINERS	NWTPH-HCID	NWTPH-Dx	NWTPH-Gx	8260 VOC	8260 RBDM VOCs	8260 BTEX	8270 SVOC	8270 SIM PAHs	8082 PCBs	600 TTO	RCRA Metals (8)	TCLP Metals (8)	Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Hg, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Tl, V, Zn TOTAL DISS TCLP	1200-COLS	1200-Z	Grain Size	TOC
SIL	- 10		3/4	10:11	Sed	2									X							X	X
SIL	- 11		3/4	10:02	Sed	2									X							X	X
SIL	- 12		3/4	9:54	Sed	2									X							X	X
SIL	- 13		3/4	9:45	Sed	2									X							X	X
SIL	- 14		3/4	9:36	Sed	2									X							X	X
SIL	- 15		3/4	9:25	Sed	2									X							X	X
SIL	- 16		3/4	9:05	Sed	2									X							X	X
SIL	- 17		3/4	8:54	Sed	2									X							X	X
SIL	- 18		3/4	8:15	Sed	2									X							X	X
SIL	- 19		3/4	8:30	Sed	2									X							X	X

Normal Turn Around Time (TAT) = 7-10 Business Days YES NO

TAT Requested (circle): 1 Day 2 Day 3 Day 4 DAY 5 DAY Other:

SAMPLES ARE HELD FOR 30 DAYS

SPECIAL INSTRUCTIONS:
PCBs - EPA 8082A
TOC - SM 5310B MOD
Grain Size - ASTM D 422M

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature: [signature] Date: 3/4	Signature: [signature] Date: 3/4	Signature: Date:	Signature: Date:
Printed Name: Alison Clements Time: 1300	Printed Name: [illegible] Time: 1300	Printed Name: Time:	Printed Name: Time:
Company: GEOSYNTEC	Company: Apex	Company:	Company:

GeoSyntec	Project: **Portland Harbor Sediment**	**Reported:**
621 SW Morrison St, Suite 600	Project Number: HPH100D	08/12/16 11:59
Portland, OR 97204	Project Manager: Keith Kroeger	

APEX LABS CHAIN OF CUSTODY

Lab # A6C0180 · COC 3 of 3

12232 S.W. Garden Place, Tigard, OR 97223 Ph: 503-718-2323 Fax: 503-718-0333

Company: GEOSYNTEC | Project Mgr: KEITH KROEGER | Project Name: PORTLAND HARBOR | Project # HPH100D

Address: 621 SW MORRISON ST. SUITE 600 PORTLAND, OR | Phone: 971-271-5901 | Fax: 971-271-5884 | Email: kkroeger@geosyntec.com

Sampled by: ALISON CLEMENTS

ANALYSIS REQUEST

Site Location: (OR) WA Other: ______

	SAMPLE ID	LAB ID #	DATE	TIME	MATRIX	# OF CONTAINERS	NWTPH-HCID	NWTPH-Dx	NWTPH-Gx	8260 VOC	8260 RBDM VOCs	8260 BTEX	8270 SVOC	8270 SIM PAHs	8082 PCBs	600 TTO	RCRA Metals (8)	TCLP Metals (8)	Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Hg, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Tl, V, Zn TOTAL DISS TCLP	1200-COLS	1200-Z
SIL 1	-20		3/14 AC		Sed	2									X						
SIL 2	21		3/14 AC		Sed	2									X						
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10																					

Normal Turn Around Time (TAT) = 7-10 Business Days (YES) NO

TAT Requested (circle): 1 Day 2 Day 3 Day 4 DAY 5 DAY Other: ______

SPECIAL INSTRUCTIONS:

SAMPLES ARE HELD FOR 30 DAYS

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature: [signature] Date: 3/14	Signature: [signature] Date: 3/14	Signature: Date:	Signature: Date:
Printed Name: Alison Clements Time: 1300	Printed Name: J. Sutter Time: 13:[illegible]	Printed Name: Time:	Printed Name: Time:
Company: GEOSYNTEC	Company: Apex	Company:	Company:

GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

APEX LABS **CHAIN OF CUSTODY**

A6C0180 revised

Lab # ______ COC 1 of 3

12232 S.W. Garden Place, Tigard, OR 97223 Ph: 503-718-2323 Fax: 503-718-0333

Company: Geosyntec | Project Mgr: Keith Kroeger | Project Name: Portland Harbor | Project # HPH100D

Address: 621 SW Morrison St. Ste. 600 Portland, OR | Phone: (971)271-5901 | Fax: (971)271-5884 | Email: kkroeger@geosyntec.com

Sampled by: AC, KK

ANALYSIS REQUEST

SAMPLE ID	LAB ID #	DATE	TIME	MATRIX	# OF CONTAINERS	8082 PCBs	Grain Size	TOC
SIL-00		3/4/2016	11:35	sed	2	x	x	x
SIL-01		3/4/2016	11:48	sed	2	x	x	x
SIL-02		3/4/2016	11:20	sed	2	x	x	x
SIL-03		3/4/2016	11:14	sed	2	x	x	x
SIL-04		3/4/2016	11:03	sed	2	x	x	x
SIL-05		3/4/2016	10:51	sed	2	x	x	x
SIL-06		3/4/2016	11:55	sed	2	x	x	x
SIL-07		3/4/2016	10:40	sed	2	x	x	x
SIL-08		3/4/2016	10:25	sed	2	x	x	x
SIL-09		3/4/2016	10:21	sed	2	x	x	x

Normal Turn Around Time (TAT) = 6-10 Business Days

TAT Requested (circle): 1 DAY 2 DAY 3 DAY 4 DAY 5 DAY Other: Normal

SAMPLES ARE HELD FOR 30 DAYS

SPECIAL INSTRUCTIONS:

PCBs - EPA 8082A; TOC - SM5310 B Mod; Grain size - ASTM D422M

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature: [signature] Date: 4-Mar	Signature: Date:	Signature: Date:	Signature: Date:
Printed Name: Alison Clements Time: 13:00	Printed Name: Time:	Printed Name: Time:	Printed Name: Time:
Company: Geosyntec	Company:	Company:	Company:

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

GeoSyntec
621 SW Morrison St, Suite 600
Portland, OR 97204

Project: **Portland Harbor Sediment**
Project Number: HPH100D
Project Manager: Keith Kroeger

Reported:
08/12/16 11:59

A6C0180 revised

APEX LABS — **CHAIN OF CUSTODY**

12232 S.W. Garden Place, Tigard, OR 97223 Ph: 503-718-2323 Fax: 503-718-0333

Lab # ______ COC 2 of 3

Company: Geosyntec | Project Mgr: Keith Kroeger | Project Name: Portland Harbor | Project # HPH100D

Address: 621 SW Morrison St. Ste. 600 Portland, OR | Phone: (971)271-5901 | Fax: (971)271-5884 | Email: kkroeger@geosyntec.com

Sampled by: AC, KK

ANALYSIS REQUEST

SAMPLE ID	LAB ID #	DATE	TIME	MATRIX	# OF CONTAINERS	8082 PCBs	Grain Size	TOC
SIL-10		3/4/2016	10:11	sed	2	x	x	x
SIL-11		3/4/2016	10:02	sed	2	x	x	x
SIL-12		3/4/2016	9:54	sed	2	x	x	x
SIL-13		3/4/2016	9:45	sed	2	x	x	x
SIL-14		3/4/2016	9:36	sed	2	x	x	x
SIL-15		3/4/2016	9:25	sed	2	x	x	x
SIL-16		3/4/2016	9:05	sed	2	x	x	x
SIL-17		3/4/2016	8:54	sed	2	x	x	x
SIL-18		3/4/2016	8:15	sed	2	x	x	x
SIL-19		3/4/2016	8:36	sed	2	x	x	x

Normal Turn Around Time (TAT) = 6-10 Business Days

TAT Requested (circle): 1 DAY 2 DAY 3 DAY 4 DAY 5 DAY Other: Normal

SPECIAL INSTRUCTIONS:

PCBs - EPA 8082A; TOC - SM5310 B Mod; Grain size - ASTM D422M

SAMPLES ARE HELD FOR 30 DAYS

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature: [signature] Date: 4-Mar	Signature: Date:	Signature: Date:	Signature: Date:
Printed Name: Alison Clements Time: 13:00	Printed Name: Time:	Printed Name: Time:	Printed Name: Time:
Company: Geosyntec	Company:	Company:	Company:

GeoSyntec	Project: **Portland Harbor Sediment**	
621 SW Morrison St, Suite 600	Project Number: HPH100D	**Reported:**
Portland, OR 97204	Project Manager: Keith Kroeger	08/12/16 11:59

A6C0180 Revised

APEX LABS

12232 S.W. Garden Place, Tigard, OR 97223 Ph: 503-718-2323 Fax: 503-718-0333

CHAIN OF CUSTODY

Lab # ____________

COC 3 of 3

Company: Geosyntec | Project Mgr: Keith Kroeger | Project Name: Portland Harbor | Project # HPH100D

Address: 621 SW Morrison St, Ste. 600 Portland, OR | Phone: (971)271-5901 | Fax: (971)271-5884 | Email: kkroeger@geosyntec.com

Sampled by: AC, KK

ANALYSIS REQUEST

SAMPLE ID	LAB ID #	DATE	TIME	MATRIX	# OF CONTAINERS	8082 PCBs
SIL-20		3/4/2016		sed	2	x
SIL-21		3/4/2016		sed	2	x

Normal Turn Around Time (TAT) = 6-10 Business Days

TAT Requested (circle): 1 DAY 2 DAY 3 DAY 4 DAY 5 DAY Other: __ Normal

SAMPLES ARE HELD FOR 30 DAYS

SPECIAL INSTRUCTIONS:

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature: [signature] Date: 4-Mar	Signature: Date:	Signature: Date:	Signature: Date:
Printed Name: Alison Clements Time: 13:00	Printed Name: Time:	Printed Name: Time:	Printed Name: Time:
Company: Geosyntec	Company:	Company:	Company:

APPENDIX E

Data Validation Report

Geosyntec consultants

10875 Rancho Bernardo Road, Suite 200
San Diego, CA 92127
PH 858.674.6559
www.geosyntec.com

Memorandum

Date: 8 April 2016

To: Keith Kroeger

From: Sherry Watts

Copy: Julia Caprio

Subject: Stage 2A Data Validation - Level II Data Deliverable

SITE: Portland Harbor Sediment

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of 20 sediment samples and two field duplicates, collected 4 March 2016, as part of the Portland Harbor Sediment sampling event. Apex Labs of Tigard, Oregon analyzed the samples. The samples were analyzed for the following analytical tests:

- EPA Method 8082A – Polychlorinated Biphenyls (PCBs)
- Standard Method 5310 B MOD– Total Organic Carbon

In addition to the analyses listed above the samples were also analyzed for total solids (%) by EPA Method 8000C and particle size by ASTM Method D 422m. No specific validation of these analyses were performed for the purposes of this report.

EXECUTIVE SUMMARY

Overall, based on this Stage 2A data validation covering the quality control (QC) parameters listed below, the data as qualified are usable for meeting project objectives.

Due to the presence of multiple Aroclors in the samples, the results for Aroclors 1254 and 1260 were J qualified as estimated. See Section 1.1 below for details.

The samples were handled, prepared, and measured in the same manner under similar prescribed conditions.

The data were validated per the specification of the following documents (as applicable):

- USEPA Contract Laboratory Program National Functional Guidelines (NFG) for Superfund Organic Methods Data Review, June 2008 (USEPA-540-R-08-01);
- Quality Assurance Project Plan (QAPP), Portland Harbor, Portland, Oregon prepared by Kleinfelder, November 4, 2014;
- Sampling and Analysis Plan (SAP) Baseline Sediment Sampling, Swan Island Lagoon, Portland, Oregon prepared by Geosyntec Consultants January 12, 2016;
- Pertinent methods referenced by the data package; and
- Technical and professional judgment.

The following samples were analyzed in the data set:

Laboratory ID	Client ID	Laboratory ID	Client ID
A6C0180-1	SIL-00	A6C0180-12	SIL-11
A6C0180-2	SIL-01	A6C0180-13	SIL-12
A6C0180-3	SIL-02	A6C0180-14	SIL-13
A6C0180-4	SIL-03	A6C0180-15	SIL-14
A6C0180-5	SIL-04	A6C0180-16	SIL-15
A6C0180-6	SIL-05	A6C0180-17	SIL-16
A6C0180-7	SIL-06	A6C0180-18	SIL-17
A6C0180-8	SIL-07	A6C0180-19	SIL-18
A6C0180-9	SIL-08	A6C0180-20	SIL-19
A6C0180-10	SIL-09	A6C0180-21	SIL-20
A6C0180-11	SIL-10	A6C0180-22	SIL-21

The following observations were noted on the sample receiving documentation. Samples were received at 3.4°C/3.5°C within the criteria of 4°C +/- 2°C. Error corrections were observed on the chain of custody (COC) forms using the proper procedure of a single strike through and correction; however, the dates of the corrections were missing. The sample receiving information also indicated that SIL-00 was not labeled on 1 of 2-8 oz jars, and that sample SIL-10 and SIL-21 were not listed on the containers or COC. These COC observations did not result in qualification of the data.

The sample results were flagged by the laboratory with the following qualifiers: C-07 (indicating sample extract had undergone Sulfuric Acid Cleanup by EPA Method 3665A, Sulfur Cleanup by EPA Method 3660B, and Florisil Cleanup by EPA Method 3620B in order to minimize matrix interference); and P-10 (indicating result is estimated due the presence of multiple PCB Aroclors and/or matrix interference.

1.0 POLYCHLORINATED BIPHENYLS (EPA METHOD 8082A)

Twenty sediment samples and two field duplicates were analyzed for PCBs per EPA Method 8082A. Samples for PCB analysis were air dried prior to extraction. PCB results are reported on a dry weight basis.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine any impact on data quality and usability.

⊗ Overall Assessment
✓ Holding Times
✓ Method Blank
✓ Surrogate
⊗ Matrix Spike/Matrix Spike Duplicate
✓ Laboratory Control Spike
✓ Laboratory Duplicate
⊗ Sensitivity
⊗ Field Duplicate

1.1 <u>Overall Assessment</u>

The PCB data reported in this package are considered to be usable for meeting project objectives. The results are considered to be valid; the analytical completeness defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for analysis, for the project is 100%.

The PCB sample IDs had "-RSM" appended to them by the laboratory indicating "representative sample method". This is a sample compositing method used by the laboratory prior to sample extraction to maximize sample representativeness prior to analysis.

It was noted in the laboratory report that due to the presence of multiple PCB aroclors in the samples the detected results should be considered estimated. Therefore, the detected results for Aroclor 1254 and Aroclor 1260 were "J" qualified as estimated as shown below.

Sample ID	Analytical Test	Laboratory Result (µg/kg)	Validated Result (µg/kg)	Reason Code
SIL-00-RSM	Aroclor 1254	784 P-10	784 J	13
SIL-00-RSM	Aroclor 1260	180 P-10	180 J	13
SIL-01-RSM	Aroclor 1254	841 P-10	841 J	13
SIL-01-RSM	Aroclor 1260	155 P-10	155 J	13
SIL-02-RSM	Aroclor 1254	192 P-10	192 J	13
SIL-02-RSM	Aroclor 1260	98.4 P-10	98.4 J	13
SIL-03-RSM	Aroclor 1254	89.8 P-10	89.8 J	13
SIL-03-RSM	Aroclor 1260	39.3 P-10	39.3 J	13
SIL-04-RSM	Aroclor 1254	24.7 P-10	24.7 J	13
SIL-04-RSM	Aroclor 1260	8.91 P-10	8.91 J	13
SIL-05-RSM	Aroclor 1254	25.9 P-10	25.9 J	13
SIL-05-RSM	Aroclor 1260	22.4 P-10	22.4 J	13
SIL-06-RSM	Aroclor 1254	29.2 P-10	29.2 J	13
SIL-06-RSM	Aroclor 1260	22.7 P-10	22.7 J	13
SIL-07-RSM	Aroclor 1254	49.5 P-10	49.5 J	13
SIL-07-RSM	Aroclor 1260	31.6 P-10	31.6 J	13
SIL-08-RSM	Aroclor 1254	93.0 P-10	93.0 J	13
SIL-08-RSM	Aroclor 1260	62.7 P-10	62.7 J	13
SIL-09-RSM	Aroclor 1254	58.7 P-10	58.7 J	13
SIL-09-RSM	Aroclor 1260	44.7 P-10	44.7 J	13
SIL-10-RSM	Aroclor 1254	190 P-10	190 J	13
SIL-10-RSM	Aroclor 1260	111 P-10	111 J	13
SIL-11-RSM	Aroclor 1254	65.9 P-10	65.9 J	13
SIL-11-RSM	Aroclor 1260	165 P-10	165 J	13
SIL-12-RSM	Aroclor 1254	193 P-10	193 J	13
SIL-12-RSM	Aroclor 1260	230 P-10	230 J	13
SIL-13-RSM	Aroclor 1254	59.8 P-10	59.8 J	13
SIL-13-RSM	Aroclor 1260	85.5 P-10	85.5 J	13
SIL-14-RSM	Aroclor 1254	25.7 P-10	25.7 J	13
SIL-14-RSM	Aroclor 1260	46.6 P-10	46.6 J	13
SIL-15-RSM	Aroclor 1254	33.6 P-10	33.6 J	13
SIL-15-RSM	Aroclor 1260	32.8 P-10	32.8 J	13
SIL-16-RSM	Aroclor 1254	25.7 P-10	25.7 J	13
SIL-16-RSM	Aroclor 1260	44.1 P-10	44.1 J	13
SIL-17-RSM	Aroclor 1254	22.7 P-10	22.7 J	13
SIL-17-RSM	Aroclor 1260	39.5 P-10	39.5 J	13
SIL-18-RSM	Aroclor 1254	25.8 P-10	25.8 J	13
SIL-18-RSM	Aroclor 1260	38.3 P-10	38.3 J	13

Sample ID	Analytical Test	Laboratory Result (µg/kg)	Validated Result (µg/kg)	Reason Code
SIL-19-RSM	Aroclor 1254	18.0 P-10	18.0 J	13
SIL-19-RSM	Aroclor 1260	33.2 P-10	33.2 J	13
SIL-20-RSM	Aroclor 1254	27.8 P-10	27.8 J	13
SIL-20-RSM	Aroclor 1260	38.1 P-10	38.1 J	13
SIL-21-RSM	Aroclor 1254	61.2 P-10	61.2 J	13
SIL-21-RSM	Aroclor 1260	131 P-10	131 J	13

Laboratory Flags
P-10 – Result estimated due to the presence of multiple PCB Aroclors and/or matrix interference
µg/kg – microgram per kilogram (dry weight basis)

1.2 Holding Times

The holding times listed in the SAP for the PCB analysis of a sediment sample are 14 days from collection to extraction and 40 days from extraction to analysis. The SAP-referenced holding time was not met for the sample analyses. However, based on professional and technical judgment and the information in SW-846 Chapter 4, which indicates that PCBs have no maximum recommended holding time, no qualifications were applied to the data.

1.3 Method Blanks

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Three method blanks were reported with the data (batches 6030837, 6030897, and 6030915). PCBs were not detected in the method blanks above the method detection limits (MDLs). It was noted that the method blanks were reported on a wet weight basis resulting in a lower reporting limit (RL) and MDL than those reported for the samples.

1.4 Surrogate Recovery

Surrogate recoveries were within the laboratory acceptance criteria for all of the samples.

1.5 Matrix Spikes/Matrix Spike Duplicates

MS/MSD pairs were not reported with the data set due to the limited sample volume received. Precision and accuracy were evaluated based on the laboratory control sample (LCS) section below (Section 1.6).

1.6 Laboratory Control Spike (LCS)

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). One LCS and two LCS/LCS duplicate (LCSD) pairs were reported. The results for the LCS and LCS/LCSD pairs were within the laboratory specified acceptance criteria for recovery and relative percent difference (RPD). It was noted that the LCS and LCS/LCSD pairs were reported on a weight wet basis.

1.7 Laboratory Duplicate

One laboratory duplicate sample was reported, using sample SIL-20-RSM. The relative percent difference (RPD) results in the duplicate were within the laboratory specified criteria.

1.8 Sensitivity

The SAP project specified RL and MDL for aroclors (1.33 and 0.66 ug/kg respectively) were not met with the exception of samples SIL-15-RSM and SIL-04-RSM. Elevated RLs were reported due to sample dilutions due to the presence of high concentrations of aroclors and samples being analyzed and reported on a dry weight basis.

1.9 Field Duplicate

Two field duplicate samples, SIL-20 and SIL-21, were collected with the samples. Acceptable precision (RPD ≤40%) was demonstrated between the field duplicates and the original samples SIL-17/SIL-13, respectively, with the exception of Aroclor 1260 in the SIL-13/SIL-21 field duplicate pair. Due to the RPD exceedance the results were J qualified as estimated as shown below.

Sample ID	Compound	Laboratory Concentration (ug/kg dry)	RPD (%)	Validation Concentration (ug/kg dry)	Validation Qualifier*	Reason Code*
SIL-17	Aroclor 1254	22.7	40	NA	NA	NA
SIL-20		27.8		NA	NA	NA
SIL-17	Aroclor 1260	39.5	4	NA	NA	NA
SIL-20		38.1		NA	NA	NA
SIL-13	Aroclor 1254	59.8	2	NA	NA	NA
SIL-21		61.2		NA	NA	NA
SIL-13	Aroclor 1260	85.5	42	85.5	J	7
SIL-21		131		131	J	7

ug/kg-milligrams per kilogram (dry weight basis)
NA – Not Applicable

2.0 TOTAL ORGANIC CARBON (TOC)

Twenty sediment samples were analyzed for TOC per Standard Method 5310B MOD.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine any impact on data quality and usability.

The TOC results were reported on a wet weight basis.

✓ Overall Assessment
✓ Holding Times
✓ Method Blank
✓ Laboratory Control Spike
✓ Laboratory Duplicate
⊗ Sensitivity

2.1 <u>Overall Assessment</u>

The TOC data reported in this package are considered to be usable for meeting project objectives. The results are considered to be valid; the analytical completeness defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for analysis, for the project is 100%.

2.2 Holding Times

The holding time for TOC analysis of a sediment sample is 28 days from collection to analysis. The holding time was met for the sample analysis.

2.3 Method Blanks

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). One method blank was reported with the data set (batch 6030253). TOC was not detected in the method blank above the RL.

2.4 Laboratory Control Spike

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). One LCS was reported in the data set. The results for the LCS were within the laboratory specified acceptance criteria for recovery.

2.5 Laboratory Duplicate

Two laboratory duplicate samples were reported, using sample SIL-00 and SIL-10. Duplicate RPD results were within the laboratory specified criteria.

2.6 Sensitivity

The project specified RL for TOC (100 mg/kg) referenced in the SAP was not met.

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**ATTACHMENT 1
DATA VALIDATION QUALIFIER DEFINITIONS
AND INTERPRETATION KEY
Assigned by Geosyntec's Data Validation Team**

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

J+ The analyte was positively identified; however, the associated numerical value is likely to be higher than the concentration of the analyte in the sample due to positive bias of associated QC or calibration data or attributable to matrix interference.

J- The analyte was positively identified; however, the associated numerical value is likely to be lower than the concentration of the analyte in the sample due to negative bias of associated QC or calibration data or attributable to matrix interference.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

DATA VALIDATION REASON CODES
Assigned by Geosyntec's Data Validation Team

Valid Value	Description
1	Preservation requirement not met
2	Analysis holding time exceeded
3	Blank contamination (i.e., method, trip, equipment, etc.)
4	Matrix spike/matrix spike duplicate recovery or RPD outside limits
5	LCS recovery outside limits and RPD outside limits (LCS/LCSD)
6	Surrogate recovery outside limits
7	Field Duplicate RPD exceeded
8	Serial dilution percent difference exceeded
9	Calibration criteria not met
10	Linear range exceeded
11	Internal standard criteria not met
12	Lab duplicates RPD exceeded
13	Other

RPD-relative percent difference